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THE NEW

PRACTICAL NAVIGATOR;

BEING A COMPLETE

EPITOME OF NAVIGATION:

TO WHICH ARE ADDED,

ALL THE

TABLES REQUISITE

FOR DETERMINING THE LATITUDE AND LONGITUDE AT SEA:

CONTAINING

THE DIFFERENT KINDS OF SAILING,

AND NECESSARY CORRECTIONS FOR LEE-WAY, VARIATION, &c.

EXEMPLIFIED IN

A JOURNAL AT SEA:

TOGETHER WITH

All necessary Instructions for determining the Latitude by DOUBLE ALTITUDES of the Sun, by the Moon, the Planets, and fixed Stars; and for ascertaining the LONGITUDE by the LUNAR OBSERVATIONS, and other Methods.

The Manner of finding and knowing the Planets and fixed Stars, by Calculation and Planispheres.

The Art of Surveying Sea-Coasts and Harbours.

An Abstract of Practical Seamanship, showing the Method of working a Ship in all difficult Cases at Sea.

The Manner of exercising Ship's Companies of War, describing the Exercise of the great Guns, and the requisite Manœuvres for attacking or defending a Ship.

The Method of recovering Ships in different Situations of Distress, and keeping them from a Lee-shore, with the best Means of saving Persons from Wrecks; and the Process of recovering drowned People, recommended by the Royal Humane Society; with a Variety of Articles *not to be found in any other Book of this Kind.*

THE WHOLE ILLUSTRATED WITH ENGRAVINGS, AND RENDERED EASY TO THE MOST COMMON CAPACITY.

The TABLES in this BOOK have been examined by three Persons; and, it is trusted, are the most correct extant. So that this BOOK will be found fully sufficient either for the Teacher or for Practice at Sea.

By JOHN HAMILTON MOORE,

TEACHER OF NAVIGATION.

THE EIGHTEENTH EDITION;

ENLARGED AND CAREFULLY IMPROVED,

By JOSEPH DESSIOU.

LONDON:

PRINTED FOR F. AND C. RIVINGTON; G. WILKIE AND J. ROBINSON; J. WALKER; G. ROBINSON; SCATCHERD AND LETTERMAN; C. LAW; DARTON AND HARVEY; CROSBY AND CO.; LACKINGTON, ALLEN, AND CO.; LONGMAN, HURST, REES, ORME, AND BROWNE; CADELL AND DAVIES; J. RICHARDSON; J. M. RICHARDSON; J. AND J. HARDY; R. SCHOLEY; R. PHILLIPS; AND J. JOHNSON AND CO.

1810.

Entered at Stationers' Hall.

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Refraction 1
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Zenith distance 33.19
Declination 15.51
Lat in 49.10

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Mer alt 56.30
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Suns apparent alt = 56.42
Refraction 1
56.43
90.00
Zenith dist 33.[illegible]
Declination 16.41
33.[illegible]

Printed by S. Hamilton, Weybridge.

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TO THE RIGHT HONOURABLE

JOHN JEFFREYS, EARL CAMDEN,

MASTER OF THE TRINITY-HOUSE,

THIS

MUCH-IMPROVED EDITION

OF

THE PRACTICAL NAVIGATOR

IS RESPECTFULLY DEDICATED,

BY HIS LORDSHIP'S MUCH OBLIGED,

AND VERY HUMBLE SERVANT,

JOSEPH DESSIOU.

Oct. 1, 1810.

AN ACCOUNT

OF THE

ARRANGEMENT AND IMPROVEMENTS IN THIS EDITION.

THE favourable reception which this Work has met with, emboldens me to present before the public the present Edition; in which I trust, I have introduced such improvements as will continue to me the favour which I so long have had the happiness to enjoy. In my former Editions I had digested the several Articles into a natural and simple order, and endeavoured to show how every thing might be deduced from the first and most simple principles of the Mathematics; in which, I trust, I had so far succeeded, as to render it easy to the most common capacity. How beneficial a work of this kind must be to learners cannot be doubted, when we reflect, that by being thus acquainted with the true principles of things, they will retain better what they have learned, and be enabled to make much greater progress in the art, than could otherwise possibly take place. Indeed, upon a careful perusal of the work, I found the plan I had pursued, so far as regards the parts of Navigation usually taught and practised at sea, could not be amended in the bulk, though some improvements might be made in particular parts. It particularly occurred to me, that I had invariably found young gentlemen, who attended me for a private examination, previous to their passing a public one, deficient in working an observation in all the variety of situations which may take place. In this work I have accordingly elucidated this important article, by giving a rule for every different situation, in which the observer can possibly find himself in respect of the Sun; illustrating each with a projection on the plane of the Meridian.

There is introduced into this Edition a Table for the near calculating the time of High-Water, with the assistance of the Nautical Almanack.

I pass over many others of smaller note in the first part of the book, such as partial amendments of the style, &c. in haste to give an account of the Arrangements and Additions in the latter part of this WORK, which is for the most part NEW.

Previous to the year 1767, when the first NAUTICAL ALMANACK was published, the practice of finding the Longitude at Sea was universally by account. The mode of ascertaining it by taking the Moon's distance from the Sun, or a fixed Star, commonly called the LUNAR OBSERVATIONS, was attended with difficulties insurmountable to most mariners. By the unremitting assiduity of the Astronomer Royal, to whose labours the Nautical Art is much indebted for its present high state of improvement; and by the rewards held out by Parliament, and the consequent improvements in instruments for measuring the Angular Distance; what before was considered as nearly an impossibility, is now come into almost general practice. Proud of contributing my

which you have the proportional parts of the daily difference of the Sun's declination to every minute and every six seconds, answering to every five minutes of time, and to every degree and fifteen miles of Longitude. The second and third pages contain the same proportional parts to every hour, and to every fifteen degrees of Longitude.

To the Table XVI. for turning degrees and minutes into time, and the contrary, two columns are added on the right side, for turning minutes and seconds (of an hour) into Longitude, and the reverse.

Table XVII. contains the decimal of every minute in twelve hours, being of ready use for finding the proportion of the small difference (in twelve hours) of the Moon's Parallax and Semi-diameter, by taking out the number from the Table answering to the time when the observation was taken, and multiplying the differences therewith, from the product of each cut off four figures from the right hand, the left hand figures are the answers (if no fraction remains); which must be additive or subtractive, according as they are increasing or decreasing.

The proportional part of the daily difference of the Sun's or Star's right ascension is found by taking out the number, answering to half the time required, and multiplying the difference therewith, from the product cut off four figures from the right hand, the remaining figures are the answer. Thus you avoid working by the Rule of Three.

In the precepts for finding the Longitude by Lunar observation, page 238, you are told to make use of the Log. Sine of 30 degrees*, half the sum of the apparent altitudes, and half the apparent distance.

In this edition, which has been carefully examined, improved, and corrected, by JOSEPH DESSIOU, is added Table XXVII. for reducing minutes into seconds, and the contrary, being of use in calculating the proportion of the difference of the Moon's semi-diameter and parallax in twelve hours, &c.

* The Log. Sine of 30 degrees is equal to the Natural Sine of half the Radius; and, according to Euclid, Axiom 6, Book I. what things are each of them half of the same quantity, are equal among themselves.

INDEX TO THE TABLES.

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DIRECTIONS TO THE BINDER FOR PLACING THE ENGRAVINGS.

Thomas Rowland [illegible]
[illegible]

OF FRACTIONS.

[It sometimes happens that Persons, though well acquainted with common Arithmetic, yet know very little of Fractions; but as most of the Instruments and Tables used in Navigation are decimally divided, and the Tables calculated to Tenths, &c. it becomes necessary they should be acquainted with Decimal Arithmetic; the following short Abstract of which may be found useful to the Learner.]

A FRACTION is a part of any thing; as one foot, one yard, one mile, one hour, one degree, &c.

A vulgar, or common Fraction, consists of two parts, the Numerator and the Denominator. The Denominator shows how many parts the quantity is divided into. The Numerator shows how many of those parts remain, and is always placed over the Denominator, with a line drawn between them.

A Fraction is what remains after division has been made, the remainder being the Numerator, and the divisor the Denominator; as 14 divided by 4, the quotient is 3, and 2 remains for a Numerator of a Fraction, of which 4, the divisor, is the Denominator, and is thus expressed $\frac{2}{4}$, or two fourths.

Suppose 12 inches is to be divided by 5; the number of times 5 are contained in 12 is 2, and 2 remains, which remainder is the Numerator, and 5 the Denominator, of the Fraction remaining, which is always a proper Fraction, thus, $\frac{2}{5}$; wherefore $\frac{1}{2}$, $\frac{3}{4}$, $\frac{2}{3}$, $\frac{4}{5}$, $\frac{9}{12}$, $\frac{5}{16}$, shows that these numbers were their respective remainders, after such divisions were made, and are read thus: one-half, three-fourths, two-thirds, four-fifths, nine-twelfths, and five-sixteenths.

A Decimal Fraction is a part of a unit, or one, supposed to be divided into 10, 100, 1000, 10,000, &c. equal parts. If the unit is divided into ten parts, and each of those parts into ten more equal parts, we obtain the foundation of Decimal Fractions.

In Vulgar Fractions the Numerator is set over the Denominator; but in Decimal Fractions the Numerator is distinguished by a comma, or point, placed before it, thus: ,5 ,75 ,125 is read thus, $\frac{5}{10}$, $\frac{75}{100}$, $\frac{125}{1000}$, that is, the first figure is 5-tenths, the second 75-hundredths, and the third 125-thousandth parts of unity, or one.

As whole Numbers increase their value in tenfold proportion from the right hand to the left, so Decimals decrease in the same proportion from the left hand towards the right: thus, ,5 ,05 ,005; or thus, $\frac{5}{10}$, $\frac{5}{100}$, $\frac{5}{1000}$.

To reduce a Vulgar Fraction to a Decimal.

RULE.—Add ciphers to the Numerator, and divide by the Denominator.

EXAMPLE I.

Reduce $\frac{1}{4}$ of a foot to a Decimal.

4)1,00(25
8

20
20

·

EXAMPLE II.

Reduce $\frac{3}{4}$ of a degree to a Decimal.

4)3,00(,75
28

20
20

·

EXAMPLE III.

Reduce $\frac{1}{2}$ an hour to a Decimal.

2)1,0(,5
10

·

EXAMPLE IV.

Reduce $\frac{1}{3}$ of an hour to a Decimal.

3)1,00000(,33333
9

10
9

10
9

10
9

10
9

1

EXAMPLE V.

Reduce $\frac{2}{3}$ of a degree to a Decimal.

3)2,00000(66666
18

20
18

20
18

20
18

20
18

2

To find the value of a Decimal in the different denominations of the same quantity.

RULE.—Multiply the Decimal by the parts of the integer, separating to the right hand as many Decimals as are in the multiplicand; and the figures to the left hand will be the parts of the integer required.

EXAMPLE I.

What is the proper quantity of ,25 of a foot?

,25
12

Answer, 3,00 inches.

EXAMPLE II.

What is the proper quantity of ,5 of an hour?

,5
60

Answer, 30,0 minutes.

EXAMPLE III.

What is the proper quantity of ,75 of a degree?

,75
60

Answer, 45,00 minutes.

EXAMPLE IV.

What is the proper quantity of ,333 of an hour?

,333
60

Answer, 19,980 minutes.

EXAMPLE V.

What is the proper quantity of ,666 of a degree?

,666
60

Answer, 39,960 minutes.

EXAMPLE VI.

What is the proper quantity of ,2236 of a degree?

,2236
60

Minutes, 13,4160
60

Seconds, 24,9600 Answer.

Hence the parts of an integer, whether of coins, weights, or measures, may be reduced to a Decimal, by bringing the parts of an integer into its lowest terms for a dividend, and the integer into the same terms for a divisor; the quotient will be the decimal parts of the integer, the value of which may be found by multiplying it by the component parts of the integer, and separating the number of decimal places towards the right hand, as above.

Addition of Decimals.

Addition of Decimals is performed exactly as in whole numbers, only observing to place the figures of the like denomination under each

	Degrees.		Minutes.
From	9,75		10,35
Take	6,5		6,4
Remainder	3,25	Remainder	3,95

Multiplication of Decimals.

Multiplication of Decimals is performed likewise as that of whole numbers, and as many places as there are in both the multiplicand and multiplier must be cut off towards the right hand of the product, and the numbers standing on the left hand of the point will be whole numbers, and those on the right hand will be Decimals.

EXAMPLE I.

Multiply 27,75 by 7,5

27,75
7,5
——
13875
19425
——
Answer 208,125

EXAMPLE II.

Multiply 39,25 by 6,5

39,25
6,5
——
19625
23550
——
Answer 255,125

EXAMPLE III.

Multiply 25,96 by 9,25

9,25
——
12980
5192
23364
——
Answer 240,1300

EXAMPLE IV.

Multiply 45,96 by 20,36

20,36
——
27576
13788
91920
——
935,7456

Division of Decimals.

This Rule is also worked as in whole numbers; the only difficulty is in valuing the quotient, which is done by the following Rules:

1st. If the Divisor and Dividend have the same number of Decimal parts, the quotient will be a whole number.

2d. If the Dividend has not so many places of Decimals as are in the Divisor, then so many ciphers must be annexed to the Dividend as will make them equal, and the quotient will be a whole number.

3d. But when the division is done, if the quotient has not so many figures as it should have places of Decimals, then so many ciphers must be affixed as there are places wanting.

EXAMPLE I.

Divide 208,125 by 7,5.

7,5)208,125(27,75
150
——
581
525
——
,562
525
——
,375
375

EXAMPLE II.

Divide 255,125 by 6,5

6,5)255,125(39,25
195
——
601
585
——
,162
130
——
,325
325

Rule of Three in Decimals.

Rule of Three in Decimals is worked in the same manner as common Arithmetic, that is, by multiplying the second and third terms together, and dividing by the first, the quotient will be the answer; and of the same denomination as the second term.

EXAMPLE.

```
Yards.      Shillings.      Yards.
If 3,5        6,75          12,25
                             6,75
                           ------
                             6125
                            8575
                           7350
                          --------
                    3,5)82,6875(23,625
                         70          12
                        ----        ----
                         126        7,500
                         105            4
                        ----        -----
                         ,218       2,000
                         ,210       -----
                        -----
                          ,87
                           70
```

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GEOMETRICAL DEFINITIONS.

GEOMETRY is the science which treats of the description, properties, and relations, of Magnitudes in general; of which there are three kinds or species, viz. a Line, which has only length, without either breadth or thickness; a Superficies, comprehended by length and breadth; and a Solid, which has length, breadth, and thickness.

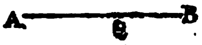
I.

A point, considered mathematically, is incapable of being divided, and therefore hath no parts, or it is the smallest part of space that can be assigned; and may be conceived so infinitely small, as to be void of length, breadth, or thickness, being always denoted by a dot, as at A.

A .

II.

A right line is the nearest distance between two points, which limit its length, without any supposed breadth, or thickness, as AB; it may be supposed to be the flowing of a point.

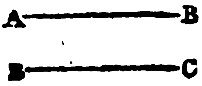


III.

A plane superficies is that which lies evenly between its extreme points, resembling a smooth table, or polished glass; bounded by lines; having length and breadth: but is conceived to have no depth or thickness, and may be conceived to be generated by the flowing of a right line.

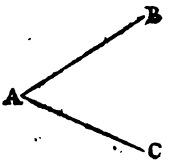
IV.

Parallel lines are such as are equally distant in all their parts, which extended infinitely on the same plane would never meet, as the lines AB, BC.



V.

A plane angle is the inclination or meeting of two right lines in one point; the point where they meet is called the angular point, and the lines AB and AC are called sides or legs; it is generally expressed by three letters: the middle one always denotes the angular point, as A, and the other two the legs or sides that include it, as AB or AC.



VI.

A circle is a plane figure, bounded by a uniform curve line; it is ordinarily described by a right line, taken with a pair of compasses; one point thereof being fixed, whilst the other is turned round to the place where the motion first began; the fixed point is called the centre, and the line described by the other point is called the circumference.

VII.

The radius of a circle, or semidiameter, is a right line drawn from the centre to the circumference, as AC; or it is that line which is taken between the points of the compasses to describe the circle; and is half its diameter AB.

VIII.

An arch of a circle is any part or portion of the circumference, as DFE.

IX.

A chord of a circle is the subtense of an arch, or it is a right line joining the ends of an arch; it divides the circle into two unequal parts, called segments, and is a chord to them both, as DE is the chord of the arches DFE and DGE.

X.

A semicircle, or half a circle, is a figure contained under the diameter, as AGB or AFB.

XI.

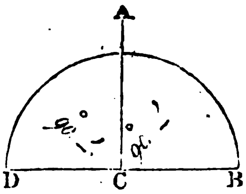
A quadrant is half a semicircle, or one fourth part of the whole circle; as the figure ACG.

NOTE. All circles, whether great or small, are actually, or supposed to have, their circumference divided into 360 equal parts, called degrees, and each degree into 60 parts, called minutes, and each minute into 60 equal parts, called seconds, and so on into thirds, fourths, &c.

All angles are measured by an arch of a circle, described round their angular points, with the chord of 60 degrees, taken from the line of chords on the plane scale, and are estimated greater or less according to the number of degrees contained betwixt their legs; and though legs be made longer or shorter, still the angle between them continues the same.

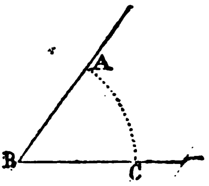
XII.

A right line is said to be PERPENDICULAR to another line, when it falls upon it so as to make the angles on each side of it equal, such as the figure ABCD, where the angle ACD is equal to the angle ACB, each a quadrant, or right angle, containing 90 degrees.



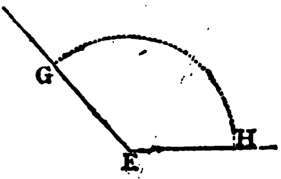
XIII.

An ACUTE ANGLE is less than a right angle, and is that which contains less than 90 degrees, as ABC.



XIV.

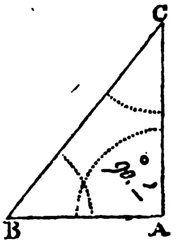
An OBTUSE ANGLE is greater than a right angle, and is that which contains more than 90 degrees, as the angle GEH.



The fewest number of right lines that can include a space are three, which form a figure called a triangle, or three-cornered figure, and consists of six parts, viz. three sides and three angles; it is distinguished into three sorts, viz. a right-angled triangle, an obtuse-angled triangle, and an acute-angled triangle.

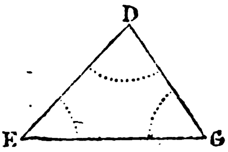
XV.

A RIGHT-ANGLED TRIANGLE has one of its angles right, or containing 90 degrees; the side opposite the right angle is called the hypotenuse, and the other two sides are called legs; that which stands upright is called the perpendicular, and the other the base: thus BC is the hypotenuse, AC the perpendicular, and AB the base; the angles opposite the two legs are both acute.



XVI.

An ACUTE-ANGLED TRIANGLE has all its angles acute, or none of them equal to 90 degrees, as DEG.



XVII.

An Obtuse-angled Triangle has one of its angles obtuse, or greater than 90 degrees, as RAF, the other two angles are acute, or less than 90 degrees, as in the triangle ARF.

Note. All triangles that are not right-angled, whether they are acute or obtuse, are in general terms called oblique-angled triangles, without any other distinction. The sum of the two acute angles of a right-angled triangle make 90°, the sum of all the angles of any triangle 180°. If from 180 you take the sum of the other two angles, the remaining angle will be found; but in a right-angled triangle, if from 90 you subtract the one angle, the other angle will remain.

MARKS OR CHARACTERS.

+ Signifies *more*, or the Sign of Addition; it shows that whatever numbers or quantity follow this sign must be added to those that go before it, thus 9+8, that is 9 added to 8. Or, A+B implies that the quantities represented by A and B are added.

— Signifies *less*, and is used as the Sign of Subtraction; it denotes that the number following it must be subtracted from those going before it, as 7—5, or 5 subtracted from 7.

× The Sign of Multiplication, and shows that the numbers placed before and after are to be multiplied, thus 7×9, that is 7 multiplied by 9, which makes 63, and 7×8×2 which makes 112.

÷ This mark stands for Division, and signifies that the number that stands before it is to be divided by the number following it, as 72÷12 shows that 72 is to be divided by 12. Or thus, $\frac{72}{12}$.

= The Sign of Equality; it shows that the numbers or quantities placed before it, are equal to those following it: thus, 8×12=96, or 8 multiplied by 12 is equal to 96, and $\overline{7+2}\times4=36$.

: :: : Proportion, and is read thus, 7 : 14 :: 10 : 20 that is, as 7 is to 14, so is 10 to 20. Or, A : B :: C : D, that is, as A is to B, so is C to D.

° Signifies Degrees, thus 45° show the number 45 degrees.

′ Signifies Minutes, thus 24′ or 24 minutes.

″ Signifies Seconds, thus 44″ or 44 seconds.

S. Stands for Sine.

Sec.——Secant.

Tan.——Tangent.

Each of these last with Co. before them, signifies the complement, as Co-sine, Co-tangent, Co-secant.

∠ Signifies Angle.

∠d Angled, with an *s* Angles, ∠s.

△ Signifies Triangle, or △s.

Z Is frequently put to signify the sum of any two lines or numbers.

Y Signifies the difference.

GEOMETRICAL PROBLEMS,

USEFUL IN NAVIGATION.

A PROBLEM *is a practical* PROPOSITION, *in which Something is proposed to be done or effected.*

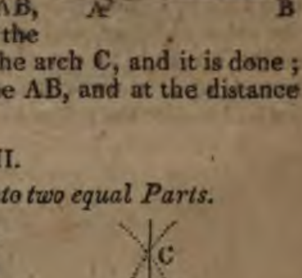
PROBLEM I.

To draw a Right Line parallel to a given Right Line, to any given Distance, as at the Point D.

WITH a pair of compasses take the nearest distance between the point D and the given right line AB: with that distance set one foot of the compasses any where on the line AB, as at A, and draw the arch C: from the point D draw a line so as just to touch the arch C, and it is done; for the line CD will be parallel to the line AB, and at the distance of the point given D, as was required.

PROBLEM II.

To bisect or divide a given Line into two equal Parts.



With any distance in your compasses greater than half the line AB, with one foot in B, describe an arch with the same distance, and one foot in A, describe an arch that will cut the former arch in C and D; through C and D draw a line, and that will cut AB in E; and the line AB will be divided at the point E into two equal parts.

PROBLEM III.

To erect a Perpendicular on the End of a given Right Line, as DB.

With any distance in your compasses, as from B to C, with one foot in C, describe the circle BDA, so that it may just touch the end of the given line at B; from whence the circle cuts the line as at D, draw a line through the points D and C, to cut the circle in A; from A draw the line AB, which will be the perpendicular required.

Or thus,

With any convenient distance in your compasses, as from D to A, with one foot in D, describe the arch AFG: set off the same distance from A to F, and from F to G; upon F and G describe two arches intersecting one another in H; draw a line from H to D, and it is done; for HD will be the perpendicular required.

PROBLEM IV.

From a given Point, as C, *to let fall a Perpendicular on a given Right Line* AB.

With one foot in C, describe an arch to cut the given line AB in F and G: with one foot in G describe an arch, and with the same distance, and one foot in F, describe an arch to cut the former in D, from C to D draw a line, and it is done; for CD will be the perpendicular required.

PROBLEM V.

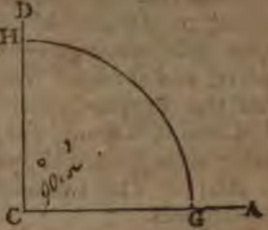
From a given Point to let fall a Perpendicular on a given Line, when the said Perpendicular is to fall so near the End of the given Line that it cannot be done as above, as at the Edge of a Sheet of Paper, &c.

Let C be the point from which the perpendicular is to be let fall on the line AB; from any point in the line AB, as at A, with the distance AC, describe an arch E; choose any other point in the line AB, as D, and with the distance DC describe another arch intersecting the former in E, join CE, and it is done; for CB will be the perpendicular required.

PROBLEM VI.

To make Plane Angles; and first a Right Angle, containing 90 Degrees.

Draw the line CA, on C erect a perpendicular CD, and it is done; for the angle DCA is an angle of 90°. Or thus: On the point C, with the chord of 60°, describe an arch GH, and set off thereon from G to H, the distance of the chord of 90°, and from C through H draw CHD, which will form the angle DCA of 90° required.



PROBLEM VII.

To make an Acute Angle equal to any number of Degrees, suppose 36° 30′.

Draw the line BC; with the chord of 60° or radius in your compasses, and one foot on C, draw the arch FB, on which set off 36° 30′, or 36½, from B to F; through F and the centre C, draw the right line AC, and it is done; for the angle ACB will be an angle of 36° 30′ as was required.

PROBLEM VIII.

To make an Obtuse Angle, that shall contain 127° 20′.

Draw CB, take the chord of 60° in your compasses, and with one foot on C describe an arch: now, as we can take off only 90°, set off 90 from B to G, and from G to E set off the excess above 90°, which is 37° 20′, or 37⅓; draw the line CE; and it is done, for the angle ECB will be an angle of 127° 20′.

PROBLEM IX.

The Angles and Hypotenuse of a Right-angled Triangle given, to find either of the Legs.

Given the hypotenuse 250 leagues, the angle opposite the base 54° 30′, consequently the other angle 35° 30′; the base and perpendicular are required.

Draw the line CB, and at C make an angle equal to 35° 30′ by drawing the line CA, take 250 from any convenient scale of equal parts, and set it off from C to A; from A let fall the perpendicular AB, to cut the line CB, and it is done; for AB measured on the same scale gives 145, and CB 203.6 leagues.

NOTE. The two acute angles of a right-angled triangle make 90 degrees.

PROBLEM X.

The Angles and one Leg of a Right-angled Triangle being given, to find the Hypotenuse and the other Leg.

The angle ACB 33° 15′, the leg AC 285 miles, to find the hypotenuse and the other leg AB.

Draw the base AC, lay off on it 285 from your scale of equal parts, from A to C; on A erect the perpendicular AB: with the chord of 60° sweep the arch AD, and on it set off 33¼°, from your line of chords from A to D, through D and C; draw the right line BC, then BC will measure 341 nearly, and BA 187 nearly, on the same scale of equal parts that AC was taken from.

PROBLEM XI.

The Hypotenuse and one Leg given, to find the Angles and the other Leg.

The leg AB 350, the hypotenuse 600 given, to find the angles, and leg BC.

Draw the base CB, on B erect the perpendicular AB, on which set off 350 from B to A; on the point A, with an opening of 600, draw an arch to cut the line BC, in the point C; draw AC, and it is done; for the angle ACB will measure 35° 41′ on the line of chords, and BC will measure 487 nearly, on the same scale of equal parts before used.

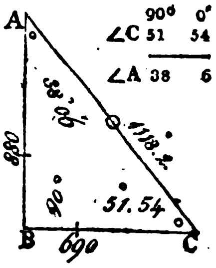
PROBLEM XII.

The Legs given, to find the Angles and the Hypotenuse.

	90°	0′
∠C	51	54
∠A	38	6

The leg AB 880 and BC 690 given, to find the angles A and C, and the hypotenuse AC.

Draw the base BC; on B erect the perpendicular AB, make BC equal to 690, and AB equal to 880; join AC, and it is done; for the angle C being measured as before, will be found as per figure, and the hypotenuse will measure 1118.2.



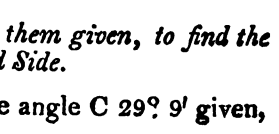
PROBLEM XIII.

Two Angles and one Side of an Oblique-angled Triangle given, to find either of the other Legs.

∠B	45°	15
∠D	108	30
	153	45
	180	0
∠C	26	15

The angle BDC 108° 30′, and CBD 45° 15′, and consequently the angle BCD 26° 15′, and the leg BC 98 given, to find the sides CD and BD.

Draw the line BC, which make equal to 98, on the point B describe an angle of 45° 15′, then add 45° 15′ to 108° 30′ and the sum 153° 45′ taken from 180, the remainder is the angle BCD=26° 15′; from the point C describe an arch with the chord of 60, and set off 26° 15′, and it is done; for the side BD will be 46 nearly, and DC 73,4, as was required.

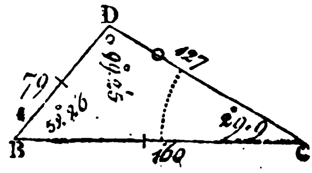


PROBLEM XIV.

Two sides and an Angle opposite to one of them given, to find the other Angle and the third Side.

The side BC 160, and BD 79, and the angle C 29° 9′ given, to find the angle D, and the side CD.

Draw the line BC equal to 160, on C make the angle DCB equal to 29° 9′ take 79 in your compasses, and with one foot on B, lay the other upon the line CD, draw the line BD, and it is done; for the angle D will be 99° 25′, the angle B 51° 26′, and the side DC 127 nearly.



PROBLEM XV.

Two Sides and their contained Angle given, to find either of the other Angles, and the third Side.

The side BC 109, BD 76, and angle CBD 101° 30′ given, to find the angles BDC or BCD, and the side CD.

Draw the line BC, which make equal to 109; on B describe an arch, on which set off from BC towards D 101° 30′, then draw the line BD equal to 76, join DC, and it is done; for the angle BDC will be 47° 32′, the angle BCD 30° 58′, and the side DC will be 145, as was required.

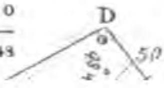
PROBLEM XVI.

Three Sides given, to find the Angles.

The sides BC 105, BD 85, and CD 50 miles given, to find the angles BDC, BCD, and CBD.

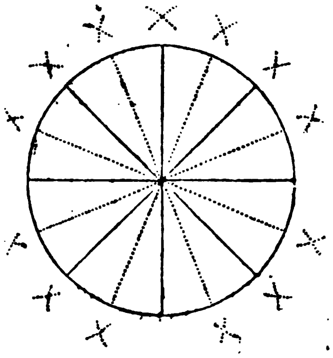
∠B	28°	4′
∠C	53	8
	81	12
	180	0
∠D	98	48

Draw the line BC equal to 105, take CD equal to 50 in your compasses, and with one foot in C, describe an arch as at D, then take BD 85 in your compasses, and with one



PROBLEM XVIII.

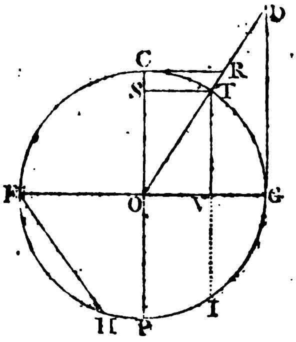
To divide a Circle into any Number of equal even Parts, as 4, 8, 16, 32.



First draw the diameter through the centre, which will divide it into two equal parts; bisect the diameter with another right line perpendicular thereto, and the circle will be divided into four equal parts or quadrants; bisect each of these quadrants again by right lines drawn through the centre, and it will be divided into eight equal parts, and so may you continue on your bisections any number of times, that is 4, 8, 16, 32, &c. doubling the number of even parts.

This problem is useful in constructing the Mariner's Compass.

I. A chord or subtense of an arch, is a right line that divides the circle into two unequal parts, and is a chord to them both as FH, TI.



II. A right sine of an arch is a line drawn from the end or termination of an arch, perpendicular to the radius, or is half the chord of twice the arch, so that TV is the sine of the arch TG, and of the arch TF, the sum of which arches together make 180°, or a semi-circle.

III. The versed sine of an arch is part of the diameter intercepted between the right sine and the arch, as VG.

IV. The tangent of an arch is a line drawn perpendicular to the end of the radius, or diameter, just touching the arch, as DG.

V. The secant of an arch is a right line drawn from the centre though the circumference, meeting the end of the tangent line to the same arch, as OD is the secant of the arch TG, to which DG is tangent; also OR is the secant of the arch CT, to which CR is the tangent.

NOTE. Sines, Tangents, Secants, are said to be the measure of so many degrees as the arch contains parts of 360, so that radius being the sine of a quadrant, or a fourth part of the circumference, contains 90 degrees; thus the radius is always equal to the sine of 90°, as is also the tangent of 45°, and the chord of 60°.

PROJECTION

OF THE

LINES OF SINES, TANGENTS, AND SECANTS,

ON THE PLANE SCALE.

1st. WITH the radius you intend for your scale, describe a semi-circle ADBC, and upon the centre C raise the perpendicular CD, (which will divide the semi-circle into two quadrants, AD, BD), continue CD directly to S, and upon B raise the perpendicular BT, then draw the right lines BD and AD.

2dly. Divide the quadrant BD into 9 equal parts, then will each of these be 10 degrees. Again, you may subdivide each of these parts into single degrees; and these again, if your radius admits it, into minutes, or some aliquot parts of a degree greater than minutes.

3dly. Set one foot of the compasses in B, and transfer each of the divisions in the quadrant BD to the right line BD, then is BD a line of chords.

4thly. From the points 10, 20, 30, &c. in the quadrant BD, draw right lines parallel to CD, till they cut the radius CB, then is the line CB divided into a line of sines, which must be numbered from C towards B.

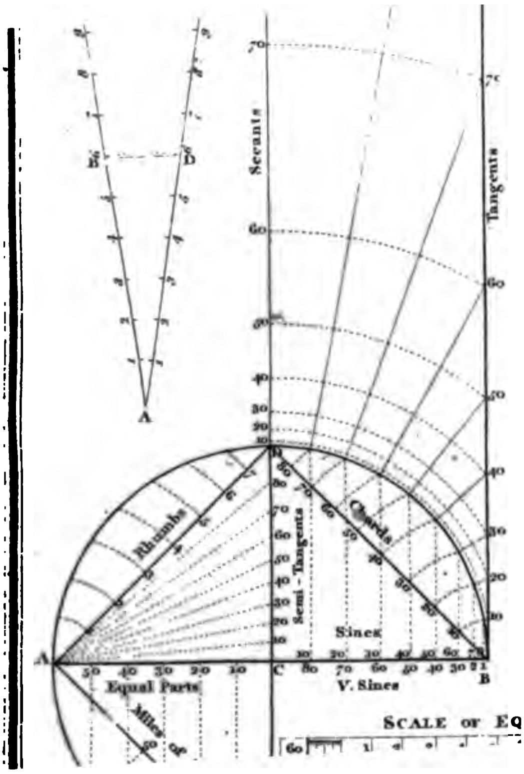
5thly. If the same line of right sines be numbered fróm B towards C, it will become a line of versed sines, which may be continued to 180°, if the same divisions be transferred on the same line on the other side of the centre C.

6thly. From the centre C, through the several divisions in the quadrant BD, draw right lines till they cut the tangent BT, so will the line BT become a line of tangents.

7thly. Setting one foot of the compasses in C, extend the other to the several divisions 10, 20, 30, &c. on the tangent line BT, and transfer these extents severally into the right line CS, then will the line CS, be a line of secants.

8thly. Right lines drawn from A to the several divisions, 10, 20, 30, &c. in the quadrant BD, will divide the radius CD into a line of semi-tangents.

9thly. Divide the quadrant AD into eight equal parts, and from A transfer these divisions severally into the line AD, then is AD a line of rhumbs, each division answering to 11° 15′ upon the line of chords.


Secants
Tangents
Rhumbs
Chords
Semi-Tangents
Sines
V. Sines
Equal Parts
Miles
SCALE OF EQ

The use of this line is for protracting and measuring of angles, according to the common division of the Mariner's Compass. If the radius AC be divided into 100, or 1000, &c. equal parts, and the lengths of the several sines, tangents, and secants, corresponding to the several arches of the quadrant be measured thereby, and these numbers be set down in a table, each in its proper column, you will, by these means, have a triangular canon of numbers, by which the several cases in Trigonometry may be solved, the right lines, graduated as above, being placed severally upon a ruler, form the instrument called the Plane Scale; by which the lines and angles of all triangles may be measured. All right lines, as the sides of plane triangles, &c. when they are considered simply as such, without having any relation to a circle, are measured by scales of equal parts, one of which is subdivided equally into 10, and this serves as a common division to all the rest. In most scales an inch is taken for a common measure to determine their largeness and number of parts; what an inch is divided into is generally set at the end of the scale, as in the scales A, B, and C; the numbers 10, 20, 30, 45, shew that so many parts, of the scales A, B, C, are contained in an inch. By any scale of equal parts, divided as above, any number less than 100 may be readily taken; but, if the number should consist of three places of figures, the value of the third figure can only be guessed at; wherefore, in these scales, it is better to use such a scale as D, called a diagonal scale, by which any number of three figures may be exactly found.

Having prepared a ruler of convenient breadth for your scale, (which may be an inch, more or less), first, near the edges thereof, draw two right lines, *af*, *eg*, parallel to each other; then divide one of these lines, as *af*, into equal parts, according to the largeness you intend your scale; and through each of these divisions draw perpendicular right lines as far as the line c d; next divide the breadth into 10 equal parts, and through each of these divisions draw right lines parallel to the former a f and e g; again divide the length a, c, d, g, each into 10 equal parts, and from the point c to the first division in the line d g, draw a right line; then parallel to that line, draw right lines through all the other divisions, and the scale is done.

Besides the lines already mentioned, there is another on the plane scale, marked ML, which is joined to a line of chords; and shows how many miles, easting or westing, make a degree of longitude in every latitude; these several lines are generally put on one side of a ruler, two feet long; and on the other side are laid down a scale of the logarithms of the sines, tangents, and numbers, which is commonly called Gunter's Scale, and as it is of general use, it requires a particular description.

DESCRIPTION AND USE

OF

GUNTER'S SCALE

WHILE the reader is perusing the following, it is proper he should have a GUNTER'S SCALE before him.

Gunter's Scale hath set upon it these eight lines following:

1st. Sine rhumbs, marked (SR) is a line which contains the logarithms of the natural sine of every point and quarter point of the Mariner's Compass, figured from the left hand towards the right, with 1, 2, 3, 4, 5, 6, 7, to 8, where is a brass pin, and where it can be done, into halves and quarters.

2d. Tangent rhumbs, marked (TR) also corresponds to the logarithm of the tangent of every point of the compass, and is figured 1, 2, 3, 4, where there is a pin, and from thence towards the left hand with 5, 6, 7.

3d. The line of numbers marked (Num.) contains the logarithms of the numbers, and is figured thus; near the left hand it begins at 1, and towards the right hand is 2, 3, 4, 5, 6, 7, 8, 9; and then 1, at which is a brass centre pin, going still on 2, 3, 4, 5, 6, 7, 8, 9, and 10 at the end, where there is another brass pin; (as this line is generally much used, it requires a larger description.) The first one may be counted for 1, or 10, or 100, or 1000, and then the next 2 is accordingly 2, or 20, or 200, or 2000, &c. Again, the first 1 may be reckoned 1 tenth, or 1 hundredth, or 1 thousandth part, &c. then the next is 2 tenth, or 2 hundredth, or 2 thousand parts, &c. so that if the first one be esteemed 1, the middle 1 is then 10, and 2 to its right is 20, 3 is 30, 4 is 40, and 10 at the end is 100; again, if the first 1 is 10, the next 2 is 20, 3 is 30, so on, making the middle 1 now 100, the next 2 is 200, 3 is 300, 4 is 400, and 10 at the end is now 1000. In like manner, if the first 1 be esteemed 1 tenth part, the next 2 is 2 tenth parts, and the middle 1 is 1, and the next 2 is 2, and 10 at the end is now 10. Again, if the first 1 be counted 1 hundredth part, the next is 2 hundredth parts, the middle one is now 10 hundredth parts, or 1 tenth part, and the next 2 is 2 tenth parts, and 10 at the end is now but one whole number or integer.

As the figures are increased or diminished in their value, so, in like manner, must all the intermediate strokes, or subdivisions, be increased or diminished; that is, if the first 1 at the left hand be counted 1, then 2 (on the right hand of it) is 2, and each subdivision between them now is 1 tenth part, and so all the way to the middle 1, which now is 10, the next 2 is 20: now the longer strokes between 1 and 2 are to be counted from 1, thus; 11,

12 (where is a brass pin), then 13, 14, 15, sometimes a longer stroke than the rest, then 16, 17, 18, 19, 20, at the figure 2; and all the shorter strokes between them longer, are now each to be counted for 1 tenth part from the middle one to the next 2, now 20, from whence the longer strokes between the figures are units, thus 21, 22, 23, &c. to 3, which now is 30, and the shorter strokes each between them, now is the tenth part of an integer; from 3, each short stroke or division, is 1 tenth part of a unit. Again, if 1 at the left hand be 10, the figures between it and the middle 1 are common tens; and the subdivisions between each figure are units; from the middle 1 to 10 at the end, each figure is so many hundredths; and between these figures each longer division is 10; from the middle 1 to 2, each less division is 2 units; and, from 2 to the end, each shorter division is 5 units. From this description it will be easy to find the divisions representing any given number, thus: Suppose the point representing the number 12 was required: Take the division at the figure 1, in the middle, for the first figure, of 12; then, for the second figure, count 2 tenths, or longer strokes to the right hand, and this last is the point representing 12, where is the brass pin.

Again, Suppose the number 22 were required, the first figure being 2, I take the division to the figure 2, and for the 2d figure 2, count 2 tenths onwards, and that is the point representing 22.

Again, Suppose 1728 were required; for the first figure 1, I take the middle 1, for the second figure 7, count onwards as before, and that is 1700, then for the third 2 count 2 tenths from the last, and it represents 1720; lastly, for the 4th figure 8, estimate 8 parts out of 10 of the next smaller division, or a little less than 10, this point, last found, represents 1728.

Required the point, representing the number 435: from the 4 in the 2d interval count towards 5 on the right, three of the larger divisions, and one of the smaller, and that will be the division expressing 435, and the like of other numbers, which by a little practice is readily done.

All fractions found in this line must be decimals; and if they are not, they must be reduced into decimals, which is easily done by extending the compasses from the denominator to the numerator; that extent laid upon 1 in the middle will reach to the decimal required.

Example. Required the decimal fraction equal to $\frac{3}{4}$, extend from 4 to 3, that extent will reach from 1 on the middle to 75, towards the left hand; the like may be observed of any other vulgar fraction.

Multiplication is performed on this line, by extending from 1 to the multiplier; that extent will reach from the multiplicand to the product.

Suppose, for example, it was required to find the product of 16, multiplied by 4, extend from 1 to 4, that extent will reach from 16 to 64, the product required.

Division being the reverse of multiplication, therefore extend from the divisor to unity, that extent will reach from the dividend to the quotient.

Suppose 64 to be divided by 4, extend from 4 to 1, that extent will reach from 64 to 16, the quotient.

N. B. This extent in division is to be taken backwards from the dividend to the quotient, but in multiplication it is taken forward from the multiplicand to the product, they being contrary to one another.

Proportion, or the Rule of Three, being performed by multiplication and division, therefore extend from the first term to the second, that extent will reach from the third term to the fourth.

Example. If the diameter of a circle be 7 inches, and the circumference 22, what is the circumference of another circle, the diameter of which is 14 inches?

Extend from 7 to 22, that extent will reach from 14 to 44 the same way.

In like manner may any other proportion, of any denomination, be worked, which makes this line of general use, particularly in measuring superficies and solids, which is done by extending from 1 to the breadth, that extent will reach from the length to the superficial content.

Example. Suppose a plank or board 15 inches broad, and 27 feet long, the content of which is required.

Extend from 1 to 1 foot 3 inches, =1.25, that extent will reach from 27 feet to 33.75 feet, the superficial content. Or extend from 12 inches to 15, &c.

The solid content of any bale, box, chest, &c. is found by extending from 1 to the breadth, that extent will reach from the depth to a fourth number, and the extent from 1 to that fourth number, will reach from the length to the solid content.

Example 1st. What is the content of a square pillar, whose length is 21 feet 9 inches, and breadth 1 foot 3 inches?

The extent from 1 to 1.25, will reach from 1.25 to 1.56, the content of 1 foot in length; again, the extent from 1 to 1.56, will reach from the length 21.75 to 33.98 or 34, the solid content in feet.

Example 2d. Suppose a square piece of timber, 1.25, feet broad, .56 deep, and 36 long, be given, to find the content.

Extend from 1 to 1.25, that extent will reach from .56 to .7, then extend from 1 to .7, that extent will reach from 36 to 25.2 the solid content. In like manner may the contents of any bales, &c. be found, which, divided by 40, will give the tonnage.

3dly. The line of sines, marked (Sin.) begins at the left hand, and is figured thus: 1, 2, 3, 4, 5, &c. to 10; then 20, 30, 40, &c. to 90, ending at the right hand, where is a brass centre pin, here, and in all lines under it, are called degrees.

4thly. The line of versed sines, marked (V. S.) begins at the right hand, against 90° on the sines, and from thence figured towards the left hand, thus: 10, 20, 30, 40, &c. end at the left

hand—about 169°; each of the subdivisions, from 10 to 30, are 2 degrees, and from thence to 90, it is single degrees, and from thence to the end, each degree is divided into 15 minutes.

5thly. The line of tangents, marked (Tang.) begins at the left hand, as do the sines; from thence it is figured to the right hand, thus: 1, 2, 3, &c. to 10, and so on, 20, 30, 40, and 45, at the right hand, where is a little brass pin, just under and even with 90° in the sines; from thence back again it is figured 50, 60, 70, 80, &c. to 89, ending at the left hand where it began at 1 degree. The subdivisions of this line are the same as those of the sines.

6thly. The line of the meridional parts, marked (Mer.) begins at the right hand, and is numbered thus: 10, 20, 30, to the left hand, where it ends at 87 degrees. This line, with the line of equal parts, marked (EP) under it, are used together, and only in Mercator's sailing. The uppermost line contains the degree of the meridians, or latitude, in a Mercator's chart; and the lower is the equator, and contains the degrees of longitude.

ON THE

DESCRIPTION AND USE OF THE SECTOR.

THIS instrument consists of two legs or rulers, representing the radius of a circle, moveable round a joint in the centre; on each face are drawn several lines or scales from the centre to almost the end of the legs, and are drawn on both legs, that every scale may have its fellow, and are called sectoral lines. There are other lines drawn parallel to the edges of the legs, and must be used with the sector quite open, the use of which is explained in the description of the Gunter scale. On one face are two lines of chords to 60 degrees, marked Cho. or C., two scales of equal parts to 10, marked Lin. or L., two lines of secants to 75 degrees, marked Sec. or S., two lines of polygons marked pol. Upon the other face the sectoral lines are two scales of sines to 90 degrees, marked Sin. or S., two lines of tangents to 45 degrees, marked, Tan. or T., two lines of upper tangents to supply the defect of the former, extending from 45 degrees to 75 degrees, and marked t.; several pair of sectoral lines are numbered from the centre, and so arranged as to make equal angles at the centre; therefore at whatever distance the sector is opened, the angles will always correspond; that is, the distance or radius from 60 to 60 on the line of chords, are equal to 10 and 10 on the line of lines, 45 and 45 on the line of tangents, and 90 and 90 on the line of sines.

The lines of chords, sines, &c. are constructed as those on the Gunter scale, making 60 on the line of chords the radius of the circle.

The sectoral lines are like so many similar triangles, namely, that their corresponding sides are proportional, thus: let AC, AE, represent in plate 1. fig. 1. a pair of sectoral lines, forming the angle CAE, divide each leg into any number of equal parts (say 10) draw lines to any of the corresponding numbers, and each will be a similar triangle to CAE, and if the lines AC, AE, should represent the line of chords, sines, or tangents, and CE the radius, and D on the chord, sine, or tangent, any proposed number, then the transverse measure BD will be the chord, sine, or tangent of that number.

In describing the use of the sector, the term *lateral distance* is the distance on one leg, only taken from the centre to any part of a sectoral line; and the *transverse distance* is that taken between any two corresponding divisions on a scale of the same name. All are measured on the lines of each scale that are nearest each other.

The Line of Lines, or Proportional Scale.

The line of lines is used to divide a given line into any number of equal parts: suppose for example 8 deg., take the length of the line given in the compasses, and make it a transverse distance from 8 to 8, then will the transverse distance from 1 to 1 be one of the equal parts, or $\frac{1}{8}$ of the whole; from 2 to 2 will be the 2d, &c.; but if the line to be divided be too long for the legs of the sector, make any division so that it may be applied to the sector, multiplying each transverse distance by the same number you divided by.

To find a fourth proportional to any 3 given lines or numbers, as suppose 6, 2, and 4, take the lateral distance of 2 in your compasses, and make it the transverse distance at 6, then the transverse distance of 4 will give the lateral distance of 1 and $\frac{1}{3}$. Or if a ship sailed 64 miles in 8 hours, how many miles did she sail in 5 hours at the same rate of sailing? Make the lateral distance of 64 the transverse distance at 8 and 8, then the transverse distance of 5 and 5 will give the lateral distance of 40, the fourth proportional. Having a chart constructed upon a scale of 5 miles to an inch, the sector is adjusted to a corresponding scale, by making the transverse distance from 5 to 5 equal to one inch. And to reduce a chart of 6 inches to a degree, to one of 4 inches to a degree, make the transverse distance of 6, 6, equal to the lateral distance of 4, then any distance from the chart set off laterally the corresponding transverse distance will be the distance required. And if you have a chart of 3 inches to a mile, to enlarge to 5 inches to a mile, make the transverse distance of 3, 3, equal to the lateral distance of 5, and proceed as before. A third proportional is found to two numbers; thus having 6 and 4 given to find a third proportional, make the transverse distance at 4 and 4, the lateral distance

of 6, then the lateral distance of 4 will give the transverse distance of 2,66 nearly.

Use of the Line of Chords.

The line or scale of chords is used for protracting any angle; you open the sector to any radius within compass of the instrument, and the transverse distance to any degree required is to be laid down on the circumference of the circle; but if you want it to any particular radius, as, for instance, to one inch, make the transverse distance between 60 and 60 equal to 1 inch, then you may take off transversely any degree under 60, but for any degree above 60, lay off the radius first on the circumference, and the excess above 60 taken transversely, are to be laid off on the circumference from the radius just before laid down. The measure of any angle is found by taking the distance of the legs on the circumference, and applying it transversely on the line of chords.

Of the Lines of Sines, Tangents, and Secants.

The transverse distance on the line of sines shows the degrees, &c. required; and the transverse distance on the line of tangents to 45, do the same. But to lay off a tangent above 45 degrees, you must take the radius of the tangent 45, and open the sector that the radius just taken may just reach to 45,45 on the line of upper tangents marked t, or on the beginning of the scale of secants, then the sector is adjusted to take any tangent above 45 degrees, or any secant to 75 degrees.

The Line of Polygons.

Open the sector that 6,6 be equal to the radius, then the transverse distance of any of the numbers on the scale will divide the circle into as many sided polygons.

LOGARITHMS.

LOGARITHMS are a series of numbers, invented by Lord Napier, Baron of Marchinston, in Scotland, by which the work of multiplication may be performed by addition, and the operation of division may be done by subtraction; so that great time and trouble are saved thereby in the performance of all arithmetical operations; for if the logarithm of any two numbers be added together, the sum will be the logarithm of the product; and if from the logarithm of the dividend you subtract the logarithm of the divisor, the remainder will be the logarithm of the quotient. Again, if the logarithm of any number be divided by 2, the quotient will be the logarithm of the square root of that number; or, if the logarithm of any number be divided by 3, the quotient will be the logarithm of the cube root of that number.

The most convenient series now made use of is the following:

0	1	2	3	4	5	&c. index.
1	10	100	1000	10000	100000,	&c. logarithms.

By which you perceive the index of any logarithm always one less than the number of figures the integer contains.

To find the Logarithm of any Number containing less than 5 Figures.

EXAMPLES.

I would find the logarithm of 7.

Look in the table for the number of 7 in the side column, and against it is 0.84510. This number having but one figure, the index thereto is 0.

I would find the logarithm of 79.

Look in the table for the number of 79 in the side column, and against it is 1.89763; to which 1 is the index, because the number contains two figures.

I would find the logarithm of 763.

Against 763, in the first side column, is 2.88252; to which prefix the index 2, as the number contains 3 places of figures, 2.88252.

To find the Logarithm of 7634.

Find the logarithm of the three first figures in the side column as before; and, casting your eye on the numbers on the top line of the table, look for the remaining figure 4, bring your eye to bear down that column, and right against 763 is the logarithm 88275, to which prefix the index 3, as it contains four places of figures, thus: 3.88275 is the logarithm of 7634.

To find the Logarithm of any whole Number to 5 Places of Figures.

Suppose 76345.

Look out the logarithm of the first three figures 763 in the side column, and the next figure 4 in the top column as before, and against the angle of meeting is 88275, as before. Take the difference between this logarithm and the next greater; that is, the difference between 275 and 281, which is 6; then say, by the rule of three, if 10 gives 6, what will 5 give? that is its half or 3; which added to the logarithm 88275, makes 88278; to which prefix the index 4, as it contains five places of figures; and that makes the logarithm of 76845 to be 4.88278.

Again, to find the Logarithm of any Number to 6 Places of figures, as 763458.

Find the logarithm of the 4 first places of figures as before 88275, as above; then say, if 100 gives 6 difference, what will 58 give? Answer 3; which, added to 88275, makes 88278; to which prefix its index 5, makes the logarithm of 763458 to be 5.88278.

To find the Logarithm of any mixed Number, as 763.458.

Where the integer is 763, or has only three places of figures, the rule is: Find the logarithm to all the figures, the same as if they were whole numbers as before, to which prefix always the index of the integer, which in this number is 2; so that the log. of 763.458 is 2.88278, nearly the same as above, only differing in its index.

To find the Number answering to any Logarithm to 4 *Places of Figures.*

Seek under the column 0, at the top of the table, the next less logarithm; note the number against it, and carry your eye along that line until you find the nearest logarithm next less than the given one, and you will have the fourth figure at the top of the table, which affix to the three given ones in the first side column.

What is the number to the logarithm 3.77342?—I look in column 0, and find under it, against the number 593, the logarithm 77305; and guiding my eye along that line, I find the given logarithm 77342 under the column, with 5 at the top; so that the number is 5935.

The number, if taken out by this precept, will be either the number required, or the next less.

To find the Number answering any Logarithm to 5 *Places of Figures nearly.*

Find the next less logarithm to the given one, and take the difference betwixt it and the given one; also take the difference betwixt the next greater logarithm, and next less to the given one; then say, as the difference of the next greater and next less is to 10, so is the former difference to the correction sought;—as, suppose you would find the number to the logarithm 4.59632.

4.59632			
4.59627	The nearest next log. I can find is	59627 = its num.	39470
	The next greater ditto is	59638 =	39480
5	- - - Difference	11	10

Then say, 11 : 10 : : 5 : 5 nearly the correction; which I add to the number 39470, makes the number sought to be 39475, answering to the logarithm 4.59632.

NOTE.—Aliquot or even parts may be taken of the difference between the less and greater logarithms, where it can be done, thus: In this last 5 is nearly the half of 11, as 5, the number sought, is of 10, the difference of the two numbers belonging to the greater and less logarithms, which will often save time and trouble.

MULTIPLICATION BY LOGARITHMS.

CASE I.

To find the Product of two whole or mixed Numbers.

Multiply 76	Log. =1.88081	Multiply 76.4	Log. =1.88309
by 54	1.73239	by 5.4	0.73239
Product 4104	=3.61320	Product 412.56	=2.61548

CASE II.

When both, or either, of the fractions are less than unity, as if

0.265	Log. 9.42325
0.031	8.49136
.008215	=7.91461

Here the index of a fraction is 9, when the first decimal figure, as 2, stands in the first decimal place; but if it should stand in the second decimal place, as the 3 in .031, the index will be 8; if it stood in the third decimal place, as .0031, the index would be 7. Thus the number of ciphers prefixed to any decimal, and the index of that decimal, always together make 9; so that if you take the number of ciphers prefixed to the decimal from 9 remains its proper index. In the addition reject 10 in the sum of the indices; and the proper product, or value of the product, will be obtained: By reason, if 9 represent the index of a fraction, 10 will represent, in this case, the index of unity. Indeed the index of unity may be assumed either 0, 10, 100, &c. as you please; but generally, for most uses, is not wanted to be more than 10, as in the sines, tangents, secants, &c. As 7 or 8 places of decimals are generally sufficient for all purposes, take these two more examples:

Multiply 3.72	Log. =0.57054	Multiply 59.4	Log=1.77379
by 0.00064	6.80618	by .000031	5.49136
Product .0023808	7.37672	Product .0018414	7.26515

Here the remainder to 9 is 2 in the index; therefore prefix two ciphers to the number of the log. 23808 for the product required.

DIVISION BY LOGARITHMS.

CASE I.

To divide a whole or mixed Number by a less whole or mixed Number.

RULE. From the logarithm of the dividend subtract the logarithm of the divisor, and the remainder is the logarithm of the quotient.

Divide 4104 by 54.

4104	Its logarithm is	3.61321
54	Its logarithm is	1.73239
76	Quotient =	1.88082

Divide 410.4 by 5.4.

410.4	Its logarithm is	2.61321
5.4	Its logarithm is	0.73239
76.0	Quotient =	1.88082

CASE II.

When both, or either, fractions are less than unity.

As divide .008215 by .031.

.008215	Its log. is	7.91461
.031	Its log. is	8.49136
.265	Product	9.42325

NOTE.—In the indices here I borrow 10, in the same manner as I flung it away in addition.

Divide .0023808 by 3.72.

.0023808.	Its log. is	7.37672
3.72	Its log. is	0.57054
.00064	Quotient	6.80618

NOTE.—If I had assumed the index of unity 100, then the index of the first number would have been 97 or 97.91461,

and .031	98.49136
	99.42325

So that 99 is the index of the first decimal place under 100 in this case.

Divide 59.4 by .000031.

59.4	Its log. is	1.77379
.000031	Its log. is	5.49136
.0001916	Its quotient	6.28243

NOTE.—Whatever index you make represent unity, omit it in the sum of the indices, and borrow it in the subtraction of indices, the sum or remainder will be the true index required.

TO EXTRACT THE ROOTS IN LOGARITHMS.

As the multiplying the logarithm of any number by the index of its power produces the logarithm of that power; so the division of any logarithm by its proposed index, the quotient will be the logarithm of the root required.

What is the square root of 324?

324 Its logarithm is	2)2.51054
18 Log. of the root is	1.25527

What is the cube root of 10678?

10678 Its log. is	3)4.02726
22 log. of the root is	1.34242

To find any proposed root of any decimal fraction, you must first prepare the index for the division of the proposed power, thus:— For the square you must add 10 to the index before you divide it; for the cube you must add 20 to its index before you divide it; and so on for the root of any power proposed.

EXAMPLE.—What is the square root of .001849?

.001849	Its log. is	7.26694
	Add	10.
		2)17.26694
.043	The log. of the root is	=8.63347

What is the cube root of .125?

.125	The log. is	9.09691
	Add	20.
	Sum	3)29.09691
.5	Its root	=9.69897

LICATION of LOGARITHMS in measuring Timber, Glass, Stone, and all kinds of Packages, taken on board Ships.

content of a board or feet long and 1¼ foot	Required the content of a piece of glass 2.9 feet long, and 1.75 broad?
½ or 9.5 is 0.97772	Log. of 2. 9=0.46240
¼ or 1.25 is 0.09691	1.75=0.24304
log of cont. 1.07463	5.075 =0.70544
10½ inches nearly.	The content is 5.075 feet.

anner may any dimensions be squared, and the content

d content be required of any box, bale, &c. add the lo- the length, breadth, and depth together, the sum will of the solid content.

.—What is the solid content of a box whose depth is h 2. 3, and length 4. 5 feet?

EXAMPLE.—What is the content of a cask whose head diameter is 20, the bung diameter 28, and length 40 inches?

Bung diameter	28	
Head diameter	20	
	8	Difference.
	.7	
	5.6	Number to be added to
The head diameter	20.0	
Mean diameter	25.6	

FOR WINE.		FOR BEER.	
Log. of mean diam. =	1.40824	———	1.40824
	1.40824	———	1.40824
Length 40 =	1.60206	———	1.60206
Constant log.	7.53148	———	7.44484
Log. of 89, 13 gallons the content for wine.	1.95002	Ans. 73 gall. =	1.86338 of beer.

The way these two constant multiplying logarithms were found is thus:

1st. The area of a circle, whose diameter is unity, is ,7854 decimal parts of the square thereof; so that if the square of the diameter of any circle be multiplied by ,7854, the product will be the area of the given circle: hence ,7854 is always a constant quantity whose logarithm is 9.89509.

2d. If the area of a circle be divided by 231, the number of cubic inches there are in a wine gallon, the quotient will be the number of gallons that circular area contains, at 1 inch deep: hence 231 is a constant divisor. Its logarithm is 2.36361, the arithmetical complement of which is 7.63639, which I add to the former constant logarithm 9.89509

The sum 7.53148 abating 10 in the indices, is the constant logarithm to be added, as per rule, for wine measure.

For beer measure the divisor is always 282, its log. is 2.45025, whose arithmetical complement is 7.54975
Add the constant log. 9.89509

Sum 7.44484, the constant logarithm for beer measure, as per rule, omitting 10 in the index, or subtract 2.45025 from 9.89509
Take 2.45025

Remains 7.44484, the same as above.

The common Way of finding a Ship's Tonnage at London.

RULE.—Multiply the length of the keel for tonnage by the breadth of the beam, and that product by half the breadth of the beam, and divide the last product by 94, and the quotient arising is the tonnage.

EXAMPLE.—Suppose a ship 72 feet by the keel, and 24 feet by the beam, what is the tonnage?

Length	72	log. is	1.85733
Breadth	24	do.	1.38021
Half-breadth	12	do.	1.07918
Arith. complement of log. of 94,		do.	8.02687
Tonnage 220.6			2.34359 Ans.

To find the Logarithm of the Sines, Tangents, and Secants, belonging to any Number of Degrees and Minutes required.

If the required degrees be less than 45, seek the degrees on the top, and the minutes in the left-hand column, marked M, against which, in the column signed at the top with the proposed name, stands the sine, tangent, and secant required; but when the degrees given are more than 45, seek the degrees at the bottom, and the minutes in the right-hand column, marked M at the bottom, and the proposed name at the bottom. Here it may be observed, that the degrees at the top, and minutes at the left-hand column, added to the degrees at the bottom and minutes in the right-hand column, always make 90; hence, if a sine be looked for, the co-sine or complement will be found in the adjoining column, the same may be observed of tangents and secants.

EXAMPLE I. Required the log. sign of 28° 37′.

Find 28 at the top of the page, and, in the left-hand column, Marked M at the top, find 37; against which, in the column marked with the word Sine, stands 9.68029, the logarithm of the sine of 28° 37′ required. The same may be observed of tangents and secants.

EXAMPLE II. Required the log. tangent of 67° 45′.

Find 67° at the bottom of the page, and 45 at the right-hand column marked M at the bottom; against this, in the column marked Tangent at the bottom, stands 10.38816, which is the logarithm required.

Having the sine, tangent, and secant, the cosine, co-tangent, co-secant, are always found in the adjoining columns.

The logarithm to any number of degrees above 90°, is found by subtracting the given degrees from 180°, and taking the logarithm of the remainder; or, if 90° be subtracted from the given sine, and the log. co-sine of the remainder be taken, it will give the same.

To find the Degrees, Minutes, and Seconds, corresponding to any given Logarithm.

If the degrees, minutes, and seconds, be wanted to a given logarithmic sine, or co-sine thus found, and the next greater, and the next less than the given logarithm, and the difference between the given logarithm and the next less if a sine, and the next greater if a co-sine; then say, as the difference between the next greater and next less is to 60″, so is the difference between the next less, if a sine, and the next greater if a co-sine, to the number of seconds to be annexed to the degrees and minutes found before.

EXAMPLE I.—Find the degrees, minutes, and seconds, corresponding to the log. sine 9.61405.

Next less log.	9 61382	Next less log.	9.61382
Next greater	9.61411	Given log.	9.61405
	29		23

Here the given log. is found standing between 24° 16′, and 24° 17′; then, as 29 is to 60, so is 23 to 48, which, annexed to 24° 16′, gives 24° 16′ 48″, answering to log. 9.61405.

EXAMPLE II.—Find the degrees, minutes, and seconds, corresponding to the log. co-sine 9.43297.

The nearest found between 74° 16′, and 74° 17′

74° 16′ Next greater log.	9.43323	Next greater log	9.43323
74° 17′ Next less	9.43278	Given log.	9.43297
Diff.	45	Diff.	26

Now, as 45 is to 60, so is 26 to 34″, which, annexed to 74° 16′ gives 74° 16′ 34″, the degrees, minutes, and seconds required.

To find the Logarithm of the Sine or Co-sine, for Degrees, Minutes, and Seconds.

RULE.—Find the logarithm to the degrees and minutes as before; take the difference between the logarithm and the next greater in the sine; but, if a co-sine, the next less: multiply this difference by the odd seconds, and divide the product by 60′; add the quotient to the right hand of the log. of the degrees and minutes, if a sine, but subtract it if a co-sine, the sum or difference will be the logarithm of the sine, or co-sine required.

EXAMPLE I. Required the log. sine of 24° 16′ 48″?

Sine of	24° 16′	9.61382
Sine of	24° 17′	9.61411
	Diff.	29

Now 29 multiplied by 48 gives 1392; this, divided by 60, the quotient, is 23, which, added to 9.61382, gives 9.61405, the log. of 24° 16′ 48′.

EXAMPLE II. What is the log. co-sine of 74° 16′ 34″?

Log. co-sine of	74° 16′	9.43323
Log. co-sine of	74° 17′	9.43278
	Diff.	45

Now 45 multiplied by 34=1530; this, divided by 60, gives the quotient 26 nearly; and 26 subtracted from 9.43323, leaves 9.43297, the log. co-sine of 74° 16′ 34″

If the given seconds be ½, ⅓, ¼, ⅕, or ⅙, or any other even parts of a minute, the like parts may be taken off the difference of the logarithms, and added or subtracted as above, which may be frequently done by inspection.

To find the Arithmetical Complement of any Logarithm.

The complement arithmetic of any logarithm, is what it wants of 10.00000 or 20.00000, and is used to avoid subtraction. For finding it this is the rule: Take the residue or remainder of the first figure from 9, and so of the rest, till you come to the last figure; of which take its remainder from 10, and it is done.

EXAMPLE I. — I would have the complement arithmetic of 9.69595

Let the line CD meet AB in D; on D erect the perpendicular DE, with the chord of 60° in your compasses, and one foot in D describe the arch AEB, which will be a semicircle or 180°; of which AB is the diameter, and the angles ADE and BDE are quadrants, each 90°, because ED is perpendicular to AB; now the angle BDC is less than 90°, since the two angles together make neither more nor less than 180° or a semicircle; consequently any number of right lines standing upon the same side of the line AB, and coming from the same point D, the sum of all the angles formed by such right lines, cannot exceed 180°. If the angle BDC be subtracted from 180°, the remainder will be the angle CDA; or if the angle ADC is given, the angle BDC is found in the same manner.

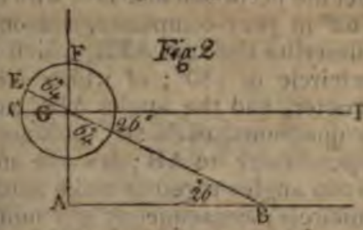
Proposition II.—If two right lines cross each other, the angles which are opposite are equal one to the other.

Let the two lines AD and CB cross each other in the point E. With the chord of 60° or any convenient radius, in your compasses, and one foot in E, describe a circle; then, by measuring the angles, it will be found that the angle AEB is equal to the angle CED, and that the angle AEC is equal to the angle BED; for the angle AEB, added to the angle AEC, makes a semicircle; and so do the angles BED and DEC; and all the angles taken together, make 360°.

Proposition III.—If a right line cross two parallel lines, the outward angles will be each equal to the inward and opposite ones.

Let the lines AB and CD be parallel lines, and EF the line that cuts them in the points G and H. With the chord of 60° in your compasses, and one foot on G and H, describe the arches BEA and DFC, which will be each a semicircle; now, by measuring the angles BGE and AGE, they will be found equal to the angles DHE and EHC, and each equal to 180, by the first proposition. In like manner it may be proved, that the two outward angles are equal to the two inward and opposite ones.

PROPOSITION IV.—In every plane triangle, whether right or oblique, the three angles are equal to two right angles, or 180°.



In the triangle A G B draw C D parallel to A B through the point G; on which point, with the chord of 60°, or any convenient radius, describe a circle; and, with the same radius, on A and B describe arches; now, by the last proposition, the angle AGB will be equal to the angle FGE, and the angle ABG will be equal to the angle CGE, and the angle BAG is equal to the angle DGF: now, since the opposite angles are equal, the angles DGF, FGE, and EGC, together, make a semicircle, or 180°; therefore it is plain that the three angles of a plane triangle, whether right, acute, or obtuse, together, are equal to two right angles or 180°: hence it follows that, as the right angle BAG, Fig. 2. is 90°, the other two acute angles, ABG, and AGB, taken together, can be no more than 90°; therefore, if one of the acute angles, in a right-angled triangle, be given, the other is found by subtracting the given angle from 90°. And in any oblique-angled triangle, if one of the angles be given, the sum of the other two is found by subtracting the given angle from 180°; and if two angles are given, the third is found by subtracting the sum of the two angles from 180°.

PROPOSITION V.—In every plane triangle, if one of its sides be produced, the outward angle will be equal to the two inward opposite angles.

Let ABC be the triangle, and CD the side produced, with the chord of 60°, or any other radius, describe arches on A, B, and C, draw CE parallel to A B; then, by the third proposition, the angle ACE must be equal to the angle BAC, and the angle DCE equal to the angle CBA; therefore the outward angle DCA is equal to the two inward opposite angles ACB, and BAC; which may be easily proved by measuring the angles by the line of chords on the plane scale.

NOTE.—I hope the learned mathematician will excuse the method here taken of demonstrating the above propositions in a mechanical manner, judging it best adapted to the capacity of those

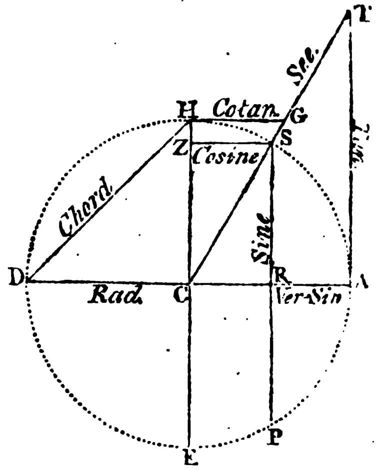
[redacted]

for whose use this book is intended, not doubting but the teacher will, as I always do, demonstrate them in a more geometrical manner to those who are capable of receiving such.

TRIGONOMETRY.

PLAIN Trigonometry is the art of measuring plane triangles, by comparing the sides and angles together by known analogies; whereby three things being given, a fourth may be found, on condition that one of them be a side: but as angles are measured by the arch of a circle, described upon their angular points, and the proportions that these arches bear to right lines cannot be exactly found; therefore the writers on Trigonometry have applied right lines to these arches, that the proportion they bear to the sides of a plane triangle may be found.

The right lines applied to a circle are:



1st. A CHORD, or the subtense of an arch, is a right line that divides the circle into two unequal parts, and is a chord to them both, as DH is the chord of the arches DH and DAH.

2d. A RIGHT SINE of an arch is, a right line drawn from one end or termination of an arch perpendicular to the radius; or it is half the chord of twice the arch; so that RS is the sine of the arch AS, and SZ the co-sine.

3d. A VERSED SINE is that part of the diameter contained between the right sine, and the arch, as RA and RCD, is the versed sine of SHD, or DEP, its equal.

4th. A TANGENT of an arch is a right line drawn perpendicular to the end of the diameter, just touching the arch, as AT is the tangent of the arch AS, and HG the co-tangent.

5th. A SECANT of an arch is a right line drawn from the centre through the circumference, and produced until it cuts the tangent at CT.

NOTE.—The sine, tangent, and secant of the complement of an arch, is called the co-sine, co-tangent, and co-secant of that arch.

The sines, tangents, and secants of an arch, are said to be the measure of so many degrees as that arch contains parts of 360 degrees; so that the radius being the sine of a quadrant, or a fourth part of a circle, contains 90°, thus: The radius is always equal to the sine of 90°, as is the chord of 60°, and the tangent of 45°, all the three being each equal to the radius: and that the sine, tangent, and secant of an arch is equal to the sine, tangent, and secant of an arch, as much above 90 degrees as the former was deficient of 90; thus the sine, tangent, or secant of 80° is = 100°, of 70° is 110°, of 60° is = 120°, of 40° is = 140°, &c. so that in taking out the logarithms of sines, tangents, or secants, for any number of degrees above 90°, the given angle must be subtracted from 180°, and the logarithm of the remainder be taken; or subtract 90° from the given angle, and take the log. co-sine, co-tangent, or co-secant of the remainder.

Notwithstanding what has been said in Geometry, it may not be improper here to observe that,

1st. The fewest number of right lines that can include a space are three: which is called a triangle, or three cornered figure, and consists of six parts, *viz.* three sides and three angles.

2d. In every triangle the greatest side is opposite the greatest angle; consequently, the greatest angle is opposite the greatest side.

3d. In every triangle equal sides subtend or stand against equal angles.

4th. In every plane triangle the three angles together are equal 180°.—See Prop. 3d, in Geometry.

5th. If in a triangle, one angle be right or obtuse, the rest are acute; and if one angle in a triangle be right, the other two taken together, make one right angle, or 90°; wherefore, if one of the acute angles, in a right-angled triangle, be known, the other is found by subtracting the known angle from 90°.

6th. In every plane triangle, if one of the angles be given or known, the sum of the other two is found by subtracting the given angle from 180°, and if two of the angles be known or given, the third is found by subtracting their sum from 180°.

7th. The complement of an angle is what it wants of 90°.

8th. The supplement of an angle is what it wants of 180°.

9th. All angles are measured by the arch of a circle, described about their angular points with the chord of 60°, and said to be greater or less, according to the number of degrees or parts to be contained between their legs; which legs may be supposed to be yards, miles, leagues, &c. and are measured on a scale of equal parts.

10th. A circle described with a chord of 60°, the circumference will contain four right angles, or 360°, the quadrant 90°, and semicircle 180°.

11th. The angles of two triangles may be respectively equal,

although their sides may be unequal. Therefore, among the things given, in order to find the rest, one of them must be a side.

In Trigonometry, the three parts given, in all triangles, must be either

1st. Two sides, and an angle opposite one of them.
2d. Two angles, and a side opposite one of them.
3d. Two sides and the included angle.
4th. Three sides.

In either case, the other three things may be found by help of the table of logarithms, artificial sines, tangents, and secants, by the following axioms; as well as by the foregoing constructions.

☞ It may not be improper here to observe, that the properties of a right angled triangle depend on the 47th proposition of the first book of Euclid, where it is demonstrated, that

In every right-angled triangle, the square of the hypotenuse, or longest side, is equal to the sum of the squares of the other two sides or legs; consequently, having the squares of the base and perpendicular, the square root of their sum will be the length of the hypotenuse.

And, if the square of the base be subtracted from the square of the hypotenuse, the square root of the remainder will be the length of the perpendicular.

And, if the square of the perpendicular be subtracted from the square of the hypotenuse, the square root of the remainder will be the length of the base; consequently, by having any two sides of a right angled triangle, the third side may be found.

Thus the lines of the lengths 5, 4, 3 (or their doubles, trebles, &c.), will form a right-angled triangle.

Now the square of 5 is 25, the square of 4 is 16, and the square of 3 is 9; then 16 and 9 is 25; its root is 5, the length of the hypotenuse; and, if 16 be subtracted from 25, the remainder is 9; its root is 3, the length of the perpendicular; again, if 9 be subtracted from 25, the remainder is 16; its root is 4, the length of the base; the same as any other numbers, which may be readily done by the logarithms, or by the extraction of the square root.

The Solution of the several Cases, in Plane Trigonometry, depends upon four Propositions, called Axioms, which the Learner should get perfectly by Heart.—We shall here give the first Axiom only, and the rest before we begin Oblique Sailing.

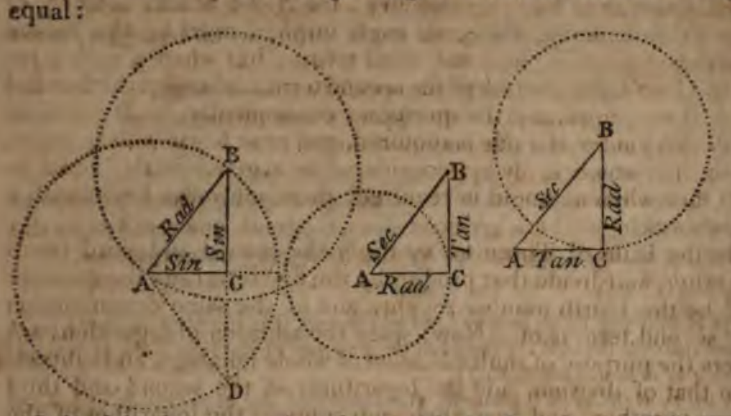
AXIOM I.

In any right-angled plane triangle,

If the hypotenuse be made the radius of a circle, the other two sides, or legs, will be the sines of their opposite angles; but,

If either of the legs, including the right angle, be made the radius of a circle, the other leg will be the tangent of its opposite angle, and the hypotenuse the secant of the same angle.

For let the three following triangles have their sides and angles equal:



It is plain, by comparing these with the first figure in Trigonometry, that, taking the hypotenuse AB as radius, in your compasses, and on A and B describe circles, CB will be the sine of the angle BAC, and CA will be the sine of the angle ABC, and BC will be the sine of half the arch BD, or the sine of half the angle BAD, being half the chord of twice the arch; but, taking the base AC, as a radius, in your compasses, and with one foot in A describe a circle, it is plain that CB will be the tangent, and AB the secant of the same angle; but if CB, the perpendicular, be taken as the radius, and a circle be described on B, then will AC be the tangent of its opposite angle ABC, and the hypotenuse the secant of the same angle: for it should be remembered, that when any one of the legs becomes a tangent of its opposite angle, the hypotenuse always accompanying it, becomes the secant of the same angle.

Now since, by making any of the sides of a right-angled triangle the radius of a circle, we can readily find the names or denominations of the other side, it comes next to be considered what parts or things are given, and what required, in order to state the question. In this case we shall compare Trigonometry with the Rule of Three in common arithmetic; where we are taught to consider what name or denomination the answer is to be of, which name must always be made the second term in stating the question; if pounds are to be the fourth number, or answer, then pounds must be the second term; if yards are to be the answer, then yards must be the second term. As for example, if 60 yards cost £.120, what will 90 yards cost? Then pounds being wanting, pounds must be the second term.

If 60 yards cost £.120, what will 90 yards cost?

$$\begin{array}{r} 90 \\ \hline 6{,}0)1080{,}0(180 \text{ Answer.} \end{array}$$

It is the same in Trigonometry; for if the fourth number, or answer, is to be an angle, an angle implied must be the second term, and sides the first and third terms; but when a side is required, a side must be placed the second term, and angles the first and third terms, in stating the question; consequently, in all questions in Trigonometry, if a side is required, you must begin with an angle; or radius, which is always considered as a given angle, equal to 90°; but when an angle is required, then you must begin with a known side.

In the Rule of Three we multiply the second and third terms together, and divide that product by the first term, and the quotient will be the fourth number sought, and of the same denomination the second term is of. Now, since the addition of logarithms answers the purpose of multiplication of whole numbers, and subtraction that of division, add the logarithms of the second and third terms together, and from their sum subtract the logarithm of the first term, the remainder will be the logarithm of the fourth term. Or to the complement arithmetic of the logarithm of the first term, add the logarithms of the second and third term, the sum abating radius will give the same answer.

As log. .. 60	1.77815	Coar. 8.22185
Is to log. of 120	2.07918	2.07918
So is log. .. 90	1.95424	1.95424
Add	4.03342	12.25527
First term sub. 60 is	1.77815	
To answer 180 =	2.25527	

Here it is plain the logarithms give the same answer as that given by the Rule of Three.

In a right-angled triangle there are always two sides, or the angles and one side, given to find the rest.

To find a side, any side may be made radius; then say, as the name of the given side is to the given side, so is the name of the side required to the side required, which must be found among the logarithms.

To find an angle, one of the given sides must be made radius; then say, as the side made radius is to radius, so is the other given side to the sine, tangent, or secant, by it represented; which being looked for in the table of sines, tangents, and secants, there will be found the degrees and minutes corresponding to the angle required.

Solution of the Six Cases in Right-angled Trigonometry.

CASE 1.

The Angle and Hypotenuse given, to find the Legs.

Given the hypotenuse AC 250 leag. and the angle opposite to the base CB=54° 30′, to find the base CB and perpendicular AB.

BY CONSTRUCTION.

Draw the base CB of any length, or C describe the arch DE, from E to D lay off 35° 30′, through C and D draw a line, which must be equal to 250; from A let fall the perpendicular AB, to cut CB in B, and it is done; for CB will be 203.5, and AB=145.2

BY CALCULATION.

By making the Hypotenuse CA Radius, it will be,

To find the base BC.		To find the perpendicular AB.	
As radius	10.00000	As radius	10.00000
Is to the hypot. CA 250	2.39794	Is to the hypot. CA 250	2.39794
So is the sine ang. A 54° 30′	9.91069	So is sine ang. C 35° 30′	9.76395
	12.30863		12.16189
	10.00000		10.00000
To the base BC=203.5	2.30863	To the per. AB 145.2	2.16189

By making the Base Radius, the proportion by Axiom the first will be,

To find the base BC.		To find the perpendicular AB.	
As sec. ang. C 35° 30′	10.08931	As sec. ang. C 35° 30′	10.08931
Is to hypo. AC=250	2.39794	Is to hypot. AC=250	2.39794
So is radius	10.00000	So is tang. ang. C 35° 30′	9.85327
	12.39794		12.25121
	10.08931		10.08931
To the base BC=203.5	2.30863	To the per. AB 145.=	2.16190

By making the Perpendicular Radius, by Axiom the first it will be,

To find the base BC.		To find the perpendicular AB.	
As sec. ang. A 54° 30′	10.23605	As sec. ang. A 54° 30′	10.23605
Is to hypot. AC 50	2.39794	Is to hypot. AC 250	2.39794
So is tang. an. A 54° 30′	10.14673	So is radius	10.00000
	12.54467		12.39794
	10.23605		10.23605
To the base BC=203,5	2.30862	To the per.=AB 145.2	2.16189

NOTE.—In the first stating, where the hypotenuse is made radius, the sum of the logarithms of the second and third terms is 12.30863, from which it is easy to subtract the logarithm of the first term; for you may either cancel it, or leave it out; and then cast off the first figure towards the left hand, and it will leave the logarithm 2.30863, the same as if 10.00000 had been set down and subtracted from it; and, indeed, the five ciphers may be always omitted in the radius, and only the index 10 set down.

It will greatly expedite the working the proportions by logarithms, if the two or all the statings be first made, and then the sines, tangents, or secants, may be taken out at one opening of the book; for if one angle of a right-angled triangle be given, the logarithm of its complement, or the other angle, whether sine, tangent, or secant, is found in the adjoining column, without being at the trouble of subtracting the given angle from 90°. If the given angle be less than 45 degrees, it is found at the top of the table, and the minutes in the left-hand column reckoned downwards; and its complement is found at the bottom, and the minutes in the right-hand column. On the contrary, if the given angle is found at the bottom, its complement, or the other angle, will be at the top of the table, and the minutes in the left-hand column, against which is the log. sine, tangent, or secant, corresponding to it.

BY GUNTER'S SCALE.

In all proportions wrought by Gunter's Scale, when the first and second terms are of the same kind, then the extent from the first term to the second, will reach from the third to the fourth;

Or when the first and third terms are of the same kind,

The extent from the first term to the third will reach from the second to the fourth; that is, set one point of the compasses on the division expressing the second term, then, without altering the opening of the compasses, set one point on the division representing the third term, or second term, and the other point will fall on the division showing the fourth term or answer.

Now, in this last case, it will run thus:

Extend from radius, or 90°, to 54°, 30', on the line of sines; that extent will reach from 250, the hypotenuse, to 203.5, the base, on the line of numbers; and the extent from radius, or sine of 90°, to 35° 30' on the line of sines, will reach from 250 to 145 on the line of numbers.

Observe the like in all that follows, except in those proportions where the word secant is mentioned, which may be readily wrought by considering the hypotenuse radius, as in the last case; there being no line of secants on Gunter's Scale.

NOTE. The radius, according to the nature of the proportion, may be any of these:

8 Points on the line of Rhumbs,	90° On the line of Sines.
4 Points on the line of Tan. Rhbs.	45° On the line of Tangents.

CASES II. and III.

The Angles and one Leg given, to find the Hypotenuse and other Leg.

The angle ACB 33° 15′, the leg BC 325 miles, given to find the hypotenuse and the other leg.

BY CONSTRUCTION.

Draw the line BC, which make equal to 325 miles; on B erect the perpendicular BA; on C describe an arch with the chord of 60°, and make the angle C=33° 15′, through where that cuts the arch draw AC to cut AB in A, and it is done; for BA being measured on the same scale that BC was, will be 213.1, and AC 388.6 miles.

By making the Hypotenuse AC Radius, it will be,

To find the perpendicular AB.		To find the hypotenuse AC.	
As sine ang. A 56° 45′	9.92235	As sine ang. A 56° 45′	9.92235
Is to the base BC 325	2.51188	Is to the base BC 325	2.51188
So is sine ang. C 33° 15′	9.73901	So is radius 90°	10.00000
	12.25089		12.51188
	9.92235		9.92235
To the perpen. AB 213,1	2.32854	To the hypot. AC 388.6	2.58953

By making the Base BC Radius, it will be,

To find the perpendicular AB.		To find the hypotenuse AC.	
As radius 90°	10.00000	As radius 90°	10.00000
Is to the base BC 325	2.51188	Is to the base BC 325	2.51188
So is tang. ang. C 33° 15′	9.81666	So is sec. ang. C 33° 15′	10.07765
	12.32854		12.58953
	10.00000		10.00000
To the perpen. AB 213.1	2.32854	To the hypot. AC 388.6	2.58953

By making the Perpendicular AB Radius, it will be,

To find the perpendicular AB.		To find the hypotenuse AC.	
As tang. ang. A 56° 45′	10.18334	As tang. ang. A 56° 45′	10.18334
Is to the base BC 325	2.51188	Is to the base BC 325	2.51188
So is radius 90°	10.00000	So is sec.ang. A 56° 45′	10.26099
	12.51188		12.77287
	10.18334		10.18334
To the perpen. AB 213.1	2.32854	To the hypot. AC 388.6	2.58953

BY GUNTER

'Extend from 56 degrees 45 minutes, to 33 degrees 15 minutes, on the line of sines, that extent will reach from the base 325, to the perpendicular 213.1, on the line of numbers.

2dly. 'Extend from 50 degrees 45 minutes to radius on the line of sines, that extent will reach from the base 325, to the hypothenuse 388.6 on the line of numbers.'

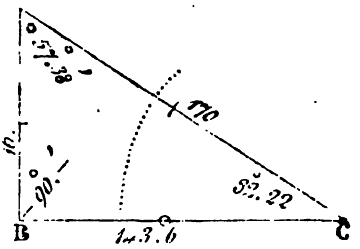
CASES IV. and V.

The Hypotenuse and one Leg given, to find the Angles and the other Leg.

The leg AB 91, the hypotenuse 170 given, to find the angle ACB, or BAC, and the leg BC.

BY CONSTRUCTION.

Draw BC at pleasure, on B erect the perpendicular BA, which make equal to 91, take 170 in your compasses, and, with one foot on A, lay the other on the line BC, and join A and C, and it is done; for the angle C will be 32° 22′, the angle A 57° 38′, and BC 143.6.



By making the Hypotenuse Radius, it will be,

To find angle C.		To find the base CB.	
As the hypot. 170	2.23045	As radius	10.00000
Is to the radius	10.00000	Is to the hypot. 170	2.23045
So is the perpend. 91	1.95904	So is sine ang. A 57° 38′	9.92667
	11.95904		12.15712
	2.23045		10.00000
To sine ang. C 32° 22′	9.72859	To the base 143.6	2.15712

y making the Perpendicular Radius, it will be,

ind the angle A.		To find the base BC.	
endicular 91	1.95904	As the radius	10.00
dius	10.00000	Is to the perpend. 91	1.95
pot. 170	2.23045	So is tang. ang. 57° 38′	10.19
	12.23045		21.15
	1.95904		10.00
. A 57° 38′	10.27141	To the base 143.6	2.15

BY GUNTER.

d from hypotenuse 170 to the perpendicular 91 on
bers; that extent will reach from radius to sine angle
ement of angle A = 32 degrees, 22 minutes, on the l

Extend from radius to sine angle A 57 degrees, 38
at extent will reach from the hypotenuse 70, to
on the line of numbers.'

CASE VI.

e Legs given, to find the Angle and Hypotenuse.

s AB 890, BC 787, given, to find the angle BAC
hypotenuse AC.

BY CONSTRUCTION

By making the perpendicular radius, it will be,

To find angle A.		To find the hypot. AC.	
As the perpend 890	2.94939	As rad. tan. 45°	10.00000
Is to rad. tan. 45°	10.00000	Is to the perpend. 890	2.94939
So is the base BC=787	2.89597	So is sec. ang. A 41° 29′	10.12543
	12.89597		13.07482
	2.94939		10.00000
To tan. ang. A 41° 29′	9.94658	To the hyp. AC=1188	3.07482

BY GUNTER.

'The extent from 787 to 890 on the line of numbers will reach from radius (or 45 degrees) to 41° 29′ on the line of tangents.

2dly. 'The extent from sine angle C 48 degrees, 31 minutes, to radius, or 90 degrees, will reach from the base 890 to the hypotenuse 1188, on the line of numbers.'

Questions to exercise the Learner in Trigonometry.

Quest. 1. The hypotenuse 496 miles, and the angle opposite to the base 56° 15′ given, to find the base and perpendicular.

Ans. Base 412.4 and the perpendicular 275.6 miles.

Quest. 2. The perpendicular 275 leagues, and the angle opposite to the base 50° 15′ given, to find the hypotenuse and base.

Ans. The hypotenuse 357.9, and base 228.7 leagues.

Quest. 3. The base 33 yards, and the angle opposite to the perpendicular 53° 26′ given, to find the hypotenuse and perpendicular.

Ans. Hypotenuse 55.39, and the perpendicular 44.49 yards.

Quest. 4. The hypotenuse 570, and perpendicular 60 miles given, to find the base.

Ans. Base 566.8 miles.

Quest. 5. The hypotenuse 150, and the base 90 miles given, to find the perpendicular.

Ans. Perpendicular 120 miles.

Quest. 6. The base 150, and perpendicular 200 leagues given, to find the hypotenuse.

Ans. Hypotenuse 250 leagues.

AN

INTRODUCTION

TO THE

ART OF NAVIGATION.

BEFORE we begin Navigation, it may not be improper to give the Learner some idea of the System of the Universe, commonly called the Solar, or Copernican System, which is as follows:—

The Sun, that immense and amazing fountain of heat and light of the whole system, is placed near the common centre of the orbits of seven opaque spherical bodies, which make their revolutions round it, in less or more time, according to their several distances from it.

Mercury is nearest to the Sun, and receives its light and heat from it, and revolves round it in ellipsis in two months and twenty-eight days.

Venus is somewhat higher in the system, and describes its ellipsis round the Sun in seven months and fifteen days, and becomes our evening and morning star by turns.

The Earth is next to Venus, and describes an ellipsis round the Sun in $365\frac{1}{4}$ days, or one year, which being at a greater distance from the Sun than the former planets, and therefore receiving less of its light and heat, to make up the deficiency, the wise Author of Nature has caused a secondary planet, called the Moon, to move round it in 27 days, 12 hours, and 44 minutes; it receives its light and heat from the Sun, and reflects it upon the Earth, which, in some measure, compensates for the absence of the Sun, during the winter seasons, in the North and South.

Mars is still higher in the System, and takes a larger circuit, revolving round the Sun in 1 year, 10 months, and 22 days.

Jupiter is the largest of all the planets, and describes a large ellipsis round the Sun, in 11 years, 10 months, 27 days; there are four Satellites, or Moons, moving round it; they receive their light from the Sun, and reflect it upon their primary planet, as the Moon does upon the Earth.

Saturn revolves round the Sun in $29\frac{1}{2}$ years, has 5 Moons which move round him, and is also surrounded with a prodigious ring or atmosphere.

The Georgium Sidus is the most remote of all the planets, and is attended by two Satellites: the first or nearest of which performs a synodical revolution in about 8 days and three quarters.

Published by J. Johnson & the rest of the Proprietors July 1.1806.

The second (which is about half as far again distant from its primary planet) is about 13 days and a half in performing its synodical revolution.

The fixed stars are supposed to be of the same matter with the Sun, and made for the same ends; each of them the centre of its own proper system, having planets moving round them, as our Sun has.

Comets are a sort of planets moving round the Sun, in ellipses, so very oblong, that their visible parts seem to be, in a manner, parabolical, but have such vast atmospheres about them, and tails derived from the same, especially when they come near the Sun, as imply them designed for very different purposes from the other planets.

Having given a cursory View of the System of the Universe, we shall now consider the Earth, a little more particularly: a perfect knowledge of the figure and motion of which, with various real and imaginary lines upon it, is absolutely necessary in the Art of Navigation.

The land and water of this Earth, or Planet upon which we live, make a composition of a spherical form, or rather an oblate figure, called the Terraqueous Globe, which, by turning round its axis every 24 hours, from West to East, causes all the heavenly bodies to revolve, apparently, from East to West in the same time, making the vicissitudes of the day and night; and this Earth, together with its Moon, by moving round the Sun in 1 year, or in 365 days 6 hours nearly, produces the seasons of the year, viz. Winter, Summer, Autumn, and Spring.

The Earth is endowed with a wonderful principle of gravitation, whereby all its parts are strictly united together; and all bodies that are loose upon it closely adhere to its surface, tending directly to its centre. Hence it is, that ships are able to sail with the same facility every where (void of impediments) upon the surface of the sea, quite round the Terraqueous Globe, and that (as to sense), there is no such thing as an upper or lower part of the Earth; for let the inhabitant be in what part soever, he will there gravitate towards the Earth's centre, and imagine himself to be on the highest point of its surface; from whence he will observe the Heavens like a large vault over his head, and his Antipodes he will imagine to be direct under him, as they will also theirs for the like reason.

According to this law of Gravity, if the Earth were at rest (and not acted upon by any other power), and its parts loose, or its surface all over covered with a deep fluid, it would naturally form itself into a true Sphere or Globe. But, admitting the earth revolves about its own axis, with a rapid motion from West to East, in 24 hours, the gravity towards its centre will thereby be disturbed, and all the parts endeavour to fly off from the axis of the motion;

and this inclination is greatest to that part of the surface, which is at the greatest distance from the axis; and, consequently, the gravity towards the centre is there the least, whence it will follow, that those parts which gravitate the least, must yield or give way to those that have a greater gravitation, to restore an equilibrium; and, consequently, here will be formed a Spheroid, whose greatest diameter will be perpendicular to the axis of motion (commonly called the Earth's axis), and the shortest diameter will be the axis itself.

It is demonstrated by the writers on mechanics, that the times of the periodical vibrations of all pendulums of equal lengths are in a certain proportion to the gravity by which they are acted upon; and it has also been demonstrated, that gravity acts in a certain proportion to the distance from its centre. Hence, by the help of pendulums, we may find the proportion of gravity upon any part of the earth; and consequently, the proportional distance of that part to the distance of any other part from the Earth's centre. Now, it has been found by experience, that the degree of gravitation upon the Earth's surface under the equinoctial, is to the same in any parallel of latitude, in the same proportion (as near as observation could be made) that it would be, if the whole body of the Earth was composed of a fluid substance, and so formed itself into such a figure as above-mentioned. Hence we may infer, that the Earth is a Spheroid; and its greatest diameter (which is under the Equinoctial) is computed to be to the lesser diameter (which is under the Poles, or the Earth's axis), as 289 to 288; and consequently, the space upon the Earth's surface, answering to a degree of a great circle where it is the greatest (or under the Equinoctial), is to the space answering to a degree near the Poles (where it is least), as 289 to 288; or as 1000 to 996,5 nearly: but this difference is so small, that in all astronomical and geographical cases, the figure of the Earth may be esteemed truly spherical, though the small difference from it does sensibly affect the motions of pendulums.

That the earth is round, or nearly so, will appear, not only from the circular shadow it has upon the Moon, when that body happens to be eclipsed by it, but also from the very appearance of the Sea, and the many observations made by persons standing upon the shore, and viewing a ship departing from the port: they first lose sight of the body of the vessel, whilst they can still see the rigging and uppermost sails: but as the ship recedes farther, they lose sight of these also, as if the whole were sunk in the deep. Again, in a ship making towards the land, the mariners first descry the tops of steeples, trees, &c. pointing above the water; next they see the buildings themselves; and lastly the shore, which can only be the effects of the Earth's rotundity.

Its being a globe is also confirmed by the many voyages which have been made round it from East to West; first by Magellan's

ship in the years 1519, 1520, 1521, in 1124 days; by Sir Francis Drake, in the years 1577, 1578, 1579, 1580, in 1056 days; by the late lord Anson, in 4 years; and lately by the Captains Byron, Carteret, Cook, and Clarke, accompanied with several able mathematicians and naturalists, whose observations and discoveries do honour to this nation, as well as greatly contribute to the improvement of Geography and Navigation: they having discovered many islands in the South Seas, which were formerly unknown to Europeans.

The little unevennesses of the Earth's surface, arising from the hills and vales, are no material objection to its being considered as round: since the highest hill or mountain bears not so great a proportion to the bulk of the Earth itself, as the little rising upon the coat of an orange bears to the bigness of that fruit.

In order to describe the position of places, geographers have found it necessary to imagine certain circles drawn upon the surface of the Earth; to which they have given the names of Equator, Meridian, Horizon, Parallels of Latitude, &c.

I. The Axis is a straight line, imagined to pass through the centre of the Earth; the extreme points are the Poles, on which the Earth is supposed to move, one called the Arctic, or North Pole, and the other the Antarctic, or South Pole.

II. The Equator is a great circle under the Equinoctial Line in the Heavens, compassing the Earth in the middle, between the two Poles, and divides it into two equal parts, called the Northern and Southern Hemispheres: from it the latitude of places is reckoned, either North or South; and on it are counted the degrees of longitude from East to West. This circle is called the Equator, because when the Sun comes to it, which is twice a year, viz. about the 21st of March, at his entrance into Aries, and again into Libra about the 23d of September, he makes equal day and night throughout the World.

III. The Meridians are circles which pass through the Poles of the Earth, the Zenith, and Nadir, crossing the Equator at right angles, and dividing the Earth into two equal parts, one East and the other West; and are so called, because, when the Sun comes to the meridian of any place, it is then noon or mid-day. They are infinite in number, for all places, from East to West, have their several meridians: of these, one is called the first or chief Meridian, from which the longitude of places is reckoned; it is of special note and use, but variously placed by geographers; some placing it at London, others at Paris, Teneriffe, &c.; and, since the Earth turns once round its axis in 24 hours, every point upon its surface describing a circle of 360 degrees in that time; therefore, any place lying 15 degrees to the East of us, has the Sun upon its meridian one hour sooner; or it is twelve o'clock with the easternmost, when it is eleven with us; and any place 15 degrees to the westward of us, has the Sun one hour after us.

IV. Latitude is the nearest distance of any place from the Equator; it is measured on an arch of the Meridian, intercepted between the place and the Equator, and therefore can never exceed 90 degrees. It takes its name according as the place is situated, either North or South of the Equator; therefore, all places that lie at the same distance from, and on the same side of, the Equator, are said to be under the same parallel of Latitude.

Parallels of Latitude are circles parallel to the Equator.

The difference of Latitude is an arch of the meridian, contained between two parallels of Latitude; or it is the least distance of the parallels of Latitude of two places, showing how far one of them is to the northward or southward of the other; and can never exceed 180 degrees.

V. The Longitude of any place on the Earth is expressed by an arch of the Equator, showing the east or west distance of the meridian of that place, from some fixed meridian, where Longitude is reckoned to begin.

Difference of Longitude is an arch of the Equator, intercepted between the meridians of two places, showing how far one of them is to the eastward or westward of the other.

Longitude begins at the meridian of some place, and is counted from thence both eastward and westward, and can never exceed 180 degrees.

VI. The Horizon is that apparent circle which limits or bounds the view of a spectator on the sea, or an extended plain; the eye of the spectator being always supposed the centre of his horizon.—Every part of this circle is 90 degrees from the centre of it over our heads, which point is called the Zenith; and the point of the Heavens opposite to it, or under our feet, is called the Nadir.

When the Sun or Stars come above the easternmost part of the Horizon, they are said to rise; and when they descend the western part, they are said to set.

When a ship is under the Equator, both the poles are in the Horizon; and, in proportion as she sails towards either, or increase her latitude, that pole is seen proportionably above the Horizon, and the other disappears as much: but when a ship is sailing towards the Equator, or decreases her latitude, she depresses the elevated pole; that is, its distance from the Horizon decreases: consequently, the latitude of a place is always equal to the elevation of the pole above the Horizon.

Note.——Here the Teacher will, perhaps, find it convenient to have a Globe, or Map of the World, before him, whereon he can point out the several Positions, Latitudes, Longitudes, &c. to the Pupil, as that will strengthen his memory, and give him a better idea than he can possibly have by only reading them over. The same may be observed in reading the use of Gunter's Scale and the Quadrant.

EXPLANATION OF GEOGRAPHICAL TERMS.

THE CIRCLES, ZONES &c. OF THE

ARTIFICIAL SPHERE OR GLOBE.

This circle is represented by the Mariner's Compass, divided into 32 points or rhumbs, each $11^{0}\ 15'$.

The Tropics are two circles parallel to the Equator, and distant from it 23 degrees, 28 minutes; that on the north side of it is called the Tropic of Cancer, at which the sun has its greatest north declination; then making to us, and all places in north latitude, the longest day and shortest night, which is about the twenty-first of June. The other, on the south side, is called the Tropic of Capricorn, at which the sun has its greatest south declination, making then our shortest day and longest night, which is about the 22d of December.

The Polar Circles are also parallel to the Equator, compassing the poles of the world at 23 degress, 28 minutes distance; that about the North Pole is called the Arctic Circle, and the other is called the Antarctic Circle.

These Tropics and Polar Circles divide the globe of the earth into 5 parts, called Zones, of which 3 were accounted by the Ancients to be so intemperate as to be uninhabitable; the Zones are called Torrid, Frigid, and Temperate; that is, 1 Torrid or Burning Zone, 2 Temperate, and 2 Frigid or Frozen Zones.

The Torrid Zone is all that space of the earth and sea which lies between the Tropics of Cancer and Capricorn, and is near 47 degrees broad: its inhabitants see the shadow of the sun turn sometimes towards one pole, and sometimes towards the other.

The two temperate Zones are those spaces of the earth and sea contained between each Tropic and the Polar Circles; the inhabitants of the North Temperate Zone have their shadows at noon fall north, and those of the South Temperate Zone have their shadows at noon fall south.

The two Frigid Zones are contained between each Polar Circle and its pole; those who inhabit them have their shadow always running round them, according to the different motions of the sun.

Climates are those tracts of the earth bounded by imaginary lines running parallel to the Equator, and of such a breadth, from south to north, that the length of the artificial day in one surpasses that in the other by half an hour.

The inhabitants of the earth are distinguished by the several meridians and parallels under which they live, and are denominated either Periæci, Antiæci, or Antipodes.

The Periæci are those people of the earth who live under the same parallels, but opposite meridians.

The Antiæci, are those people of the earth who live under the same meridians, but opposite parallels.

The Antipodes are situated directly opposite to each other, the feet of the one directly against the feet of the other, lying under opposite parallels, and opposite meridians. It is midnight with one

when it is noon-day with the other; the longest day with the one is the shortest with the other; the length of the day with the one is equal to the other's night; and the seasons are opposite, being summer with one when it is winter with the other.

The Real Parts are earth and water, generally divided into four parts or quarters, called Europe, Asia, Africa, and America; each of these, and consequently the whole Globe, is divided into continents, islands, seas, &c.

A Continent is a great quantity of land, not divided by the sea, wherein are several empires, kingdoms, and countries conjoined; as Europe, Asia, and Africa, are one Continent, and America another.

An Island is a part of the earth that is environed or encompassed round by the sea, as Great Britain and Ireland.

A Peninsula is a part of land almost surrounded with water, save one narrow neck of land which joins the same to the Continent.

An Isthmus is a narrow neck of land joining the Peninsula to the Continent, by which the people may pass from one to the other.

A Promontory is a high part of land, stretching itself into the sea, the extremity of which is called a Cape or Headland.

A Mountain is a rising part of dry land, over-topping the adjacent country, and appearing first at a distance.

The Earth being encompassed by water, whose washings, in surrounding the dry land, cut and shape many winding bays, creeks, and meandering inlets, and extending itself round them all, is but one continued ocean.

An Ocean is a vast collection of salt water, separating Continents from one another, and washing their borders or shores.

A Sea is a part of the ocean, to which we must sail through some Strait, as the Mediterranean and Baltic Seas.

A Strait is a narrow part of the ocean, lying between two shores, and opening a way into some sea, as the Straits of Gibraltar, that lead into the Mediterranean Sea, and the Sound, which leads into the Baltic Sea.

A Creek or Cove is a small narrow part of the sea or river, that goes up but a little way into the land.

A Bay is a great inlet of the land, as the Bay of Biscay, and the Bay of Mexico; otherwise a Bay is a station or road for ships to anchor in.

A River is a considerable stream of water, issuing out of one or various springs, and continually gliding along till it discharges itself into the Sea. The lesser streams are called Rivulets.

A Lake is that which continually retains and keeps water in it, as the Lake Zair, in Africa, and Nicaragua, in America.

A Gulf is a part of the Ocean or Sea, contained between two

shores, and is every where environed by land, except its entrance, where it communicates with other bays, seas, or oceans.

There are five Oceans, namely, the Northern, the Atlantic, the Pacific, the Indian, and the Southern.

The Atlantic Ocean is usually divided into two parts, one called the North Atlantic Ocean, and the other the South Atlantic or Ethiopic Ocean.

The Northern Ocean stretches to the northward of Europe, Asia, and America, towards the north pole.

The Atlantic Ocean lies between the Continents of Europe and Africa on the east, and America on the west.

That part of the North Atlantic Ocean lying between Europe and America is frequently called the Western Ocean.

The Pacific Ocean, or, as it is sometimes called, the South Sea, is bounded by the western and north-west shores of America, and by the eastern and north-east shores of Asia.

The Indian Ocean washes the shores of the eastern coast of Africa, and the south of Asia, and is bounded on the east by the Indian islands and the southern continent.

The Southern Ocean extends to the southward of Africa and America towards the south pole.

ABBREVIATIONS.

Alt. Altitude—A. M. before Noon—App. Apparent.

AR. Right Ascension—Amp. Amplitude—Aug. Augmentation—Comp. Complement.

Col. Column—Cor. Correction—Cou. Course—Dec. Declination—Dep. Departure.

Dia. Diameter—Dist. Distance—Diff. Difference—Dip. Depression of the Horizon—Ela. Elapsed.

Equ. Equation—Equa. Equator—Hor. Horizon—Lat. Latitude—Log. or L. Logarithm.

L. L. Lower Limb——Mag. Magnetic—Mer. Meridian—Merid. Meridional—Mid. Middle.

Nat. Natural—Nau. Alm. Nautical Almanac—Obs. Observed or Observation—Par Parallel.

Parx. Parallax—Perp. Perpendicular—Pol. Polar—Pro. or P. Proportional—P. M. After Noon.

Ref. Refraction—Rad. or R. Radius—L. R. Logarithm Ratio—Semi Dia. Half the Diameter.

U. L. Upper Limb—Zen. Zenith.

H

NAVIGATION.

THE great end and business of Navigation is to instruct the mariner how to conduct a ship through the wide and pathless ocean, to the remotest parts of the world, the safest and shortest way, in passages navigable.

For the due and regular performance of which are requisite—A perfect knowledge of the figure and motion of the earth, the various real and imaginary lines upon it, so as to be able to ascertain the real distance and situation of places with respect to one another, with the use of the several instruments made use of in measuring the ship's way; such as the log, half-minute glass, quadrant, or sextant, to take the altitude of the sun and stars; compass, to represent the sensible horizon; and azimuth compass, to take the azimuth or amplitude of the sun, in order to know the variation of the magnetic needle; maps and charts of the seas and lands, together with the depth of water, the times and settings of the tides upon the coasts he may have occasion to approach near; a competent knowledge of currents; of the mould and trim of the ship, and the sail she bears, that so due allowance may be made for leeway: by help of these, and skill in the navigator, he may know at all times the place the ship is in, which way he must steer, and how far, to gain his intended port.

Notwithstanding what has been said, it may not be improper here to observe, that,

As latitude is counted from the equator upon an arch of the meridian, north and south, the difference of latitude between two places, both north, or both south, is found by subtracting the less latitude from the greater; but if one latitude be north and the other south, the sum is the difference of latitude.

Consequently, if a ship in north latitude sails northerly, or in south latitude southerly, she increases her latitude; but in north latitude sailing southerly, or in south latitude sailing northerly, she decreases her latitude; because she sails nearer to the equator, from whence the latitude is reckoned.

Wherefore in north latitude sailing northerly, or in south latitude sailing southerly, the difference of latitude, added to the latitude left, gives the latitude in.

In north latitude, sailing southerly, or in south latitude, sailing northerly, the difference of latitude subtracted from the latitude left, gives the latitude in.

When the latitude decreases, and the difference of latitude is greater than the latitude sailed from, subtract the latitude left from the difference of latitude, the remainder will be the latitude in, and of a different name; for it is plain that the ship has crossed the equator.

As the longitude is counted from the first meridian east and west, until it comes to the opposite meridian, it cannot exceed 180 degrees.

The difference of longitude between two places, being both east or west, is found by subtracting the less longitude from the greater; but if one be in east longitude, and the other in west, their sum is the difference of longitude.

Therefore in east longitude sailing easterly, or in west longitude sailing westerly, the difference of longitude added to the longitude left, gives the longitude in.

In east longitude sailing westerly, or in west longitude sailing easterly, the difference of longitude subtracted from the longitude left, gives the longitude in.

When a ship sails east or west, until she passes the opposite meridian, or 180 degrees, she changes her longitude, or comes into a longitude of a different name.

What has been said will be rendered familiar to the learner by the following examples.

EXAM. I. What is the difference of latitude between London in latitude 51° 32′ N. and Rome in latitude 41° 54′ N.?

	°	′	
From London lat.	51	32	N.
Subtract Rome's lat.	41	54	N.
Rem. the Diff. of lat.	9	38	N.
	60		
Diff. in miles —	578		

EXAM. II. A ship from latitude 29° 17′ S. sails southward until her difference of latitude be 374 miles, what latitude is she come to?

		°	′	
Latitude sailed from		29	17	S.
Diff. of lat. 374÷60	=	6	14	S.
Lat. in		35	31	S.

EXAM. III. Required the difference of latitude between Cape Finisterre and Cape Roque in South America?

	°	′	
Cape Finisterre's lat.	42	53	N.
Cape St. Roque's lat.	5	6	S.
Diff. of lat.	47	59	
	60		
Diff. Lat. in miles	2879		

EXAM. IV. A ship from latitude 8° 25′ N. sails south 600 miles, what latitude is she in?

		°	′	
From diff. of lat. 600 miles, ÷ 60	=	10	00	S.
Sub. lat. left		8	25	N.
		1	35	S.

In the last example it is plain, that as the difference of latitude is more than the latitude left, the ship must have crossed the equator, and consequently come into south latitude.

NOTE. When one of the places has no latitude, or is on the equator, then the latitude of the other place is their difference of latitude.

EXAM. V. What is the difference of longitude between Cape Finisterre and the east point of Barbadoes?

	° ′
Cape Finisterre's long.	9 16 W.
Barbadoes long.	59 49 W.
Diff. of long. -	50 33 W.
	60
Diff. in miles -	3033

EXAM. VII. What is the difference of longitude between Barcelona and Lisbon?

	° ′
Barcelona's long.	2 10 E.
Lisbon's long.	9 7 W.
Diff. of long. —	11 17 W.

EXAM. IX. What is the difference of longitude between Nangasaki in Japan and St. Christopher's?

	° ′
Nangasaki's Long.	129 52 E.
St. Christopher's long.	62 42 W.
Exceeds 180° 00′	192 34
	360 00
Diff. of long. =	167 26 W.

EXAM. VI. A ship from Cape Charles, in Virginia, sails eastward till her difference of longitude be 400 miles, what longitude is she in?

	° ′
Cape Charles's long.	76 5 W.
Diff. of long. 400 miles =	6 40 E.
Long. in —	69 35 W.

EXAM. VIII. A ship from 15° 40′ E. long. sails westward till her diff. of long. be 27° 15′, what long. is she in?

	° ′
Long. left	15 40 E.
Diff. of long.	27 15 W.
Long. in —	11 35 W.

EXAM. X. A ship from longitude 160° 20′ W. sails westward until she differs her long. 41° 20′, what long. is she in?

	° ′
Long. left —	160 20 W.
Diff. of long. —	41 20 W.
	201 40
	360 00
Long. in —	158 20 E.

Here it is plain, that the ship has crossed the opposite meridian, and, therefore, has come into a longitude of a different name.

In sailing due north or south, the ship changes her latitude only; and sailing east or west, her longitude; and sailing upon any other course, she must change both latitude and longitude.

Easting or westing, in Plane Sailing, is called Departure or Meridian Distance.

The instrument used in measuring a ship's way at sea, is the Log.

Ships at sea are directed from one place to another by means of an instrument called the Mariner's Compass, which is an artificial representation of the horizon of every place, by the means of a circular piece of paper, called a card, divided like the horizon into degrees and points, which are called Rhumbs. Now the card being properly fixed to a piece of steel, called the Needle, that has been touched with a loadstone (whose property is such as to cause one end of the needle so touched to point towards the north, when turning freely on something supporting it), all the points of the card will be directed towards the corresponding points of the horizon.

A TABLE of DEGREES and MINUTES,
To every Quarter Point of the Compafs.

NORTH.	SOUTH.	H.M.	Points	° ′ ″	Points	H.M.	SOUTH.	NORTH.
		0 11	0 ¼	2 . 48 . 45	0 ¼	11 49		
		0 22	0 ½	5 . 37 . 30	0 ½	11 37		
		0 34	0 ¾	8 . 26 . 15	0 ¾	11 26		
N. by E.	S. by W.	0 . 45	1	11 . 15 . 0	1	11 15	S. by E.	N. by. W.
		0 56	1 ¼	14 . 3 . 45	1 ¼	11 4		
		1 7	1 ½	16 . 52 . 30	1 ½	10 52		
		1 19	1 ¾	19 . 41 . 15	1 ¾	10 41		
N. N. E.	S. S. W.	1 . 30	2	22 . 30 . 0	2	10.30	S. S. E.	N. N. W.
		1 41	2 ¼	25 . 18 . 45	2 ¼	10 19		
		1 52	2 ½	28 . 7 . 30	2 ½	10 7		
		2 4	2 ¾	30 . 56 . 15	2 ¾	9 56		
NE. by N.	SW. by. S.	2 . 15	3	33 . 45 . 0	3	9 . 45	SE. by. S.	NW. by. N.
		2 26	3 ¼	36 . 33 . 45	3 ¼	9 34		
		2 37	3 ½	39 . 22 . 30	3 ½	9 22		
		2 49	3 ¾	42 . 11 . 15	3 ¾	9 11		
N. E.	S. W.	3 . 0	4	45 . 0 . 0	4	9 . 0	S. E.	N. W.
		3 11	4 ¼	47 . 48 . 45	4 ¼	8 49		
		3 22	4 ½	50 . 37 . 30	4 ½	8 37		
		3 31	4 ¾	53 . 26 . 15	4 ¾	8 26		
NE. by. E.	SW. by. W.	3 . 45	5	56 . 15 . 0	5	8 . 15	SE. by E.	NW. by. W.
		3 56	5 ¼	59 . 3 . 45	5 ¼	8 4		
		4 7	5 ½	61 . 52 . 20	5 ½	7 52		
		4 18	5 ¾	64 . 41 . 15	5 ¾	7 41		
E. N. E.	W. S. W.	4 . 30	6	67 . 30 . 0	6	7 . 30	E. S. E.	W. N. W.
		4 41	6 ¼	70 . 18 . 45	6 ¼	7 19		
		4 52	6 ½	73 . 7 . 30	6 ½	7 7		
		5 4	6 ¾	75 . 56 . 15	6 ¾	6 56		
E. by. N.	W. by. S.	5 . 15	7	78 . 45 . 0	7	6 . 45	E. by. S.	W. by. N.
		5 26	7 ¼	81 . 33 . 45	7 ¼	6 34		
		5 37	7 ½	84 . 22 . 30	7 ½	6 22		
		5 49	7 ¾	87 . 11 . 15	7 ¾	6 11		
East	West	6 . 0	8	90 . 0 . 0	8	6 . 0	East	West

Published by J. Johnson & the rest of the Proprietors July 1. 1806.

Hence it follows, that in every place the north point of the card shows the position of the meridian of that place, and some one rhumb or point of the card will coincide with, or be directed along, the track that makes any given angle with the meridian; consequently, by the help of the card or compass, a ship may be kept in any proposed track or course.

A rhumb line, or point, is a right line drawn from the centre of the compass to the horizon, and is named from that point of the horizon it falls in with.

The course is the angle which any rhumb line makes with the meridian, and is sometimes reckoned in degrees, and sometimes in points of the compass; so that if a ship sails upon the second rhumb, or N. N. E., the course is 22 degrees 30 minutes: and so for any other.

One Magnus, a shepherd, first discovered the loadstone by its sticking to the iron of his sandals; whence the name Magnet was given to the stone, or Magnetic Needle. Gio, of Naples, about 300 years ago, first discovered that a piece of iron rubbed on it, and then suspended, had the property of pointing to the north and south, and thence applied it to navigation.

How to touch the Compass Needle.

Having two strong magnetical bars, lay the compass needle as nearly north and south as you can, with the intended north northward; join the two magnets in a line considerably above the needle, the north end of which being northward (round which end of each a notch is made) bring them down upon the needle, that the junction may be on its centre; then draw them asunder along on each half of the needle, and continue the motion till they are eight inches clear of the needle's end, and, by a circular motion, join them, and bring them to the centre as before, then separate them, repeating the operation seven or eight times, taking care not to put the magnets out of their parallelism, and the needle will be sufficiently magnetical.

PLANE SAILING.

PLANE SAILING is the art of navigating a ship upon principles deduced from the notion of the earth's being an extended Plane, and is no more than the application of Plane Trigonometry to the solution of the several variations, or cases; where the hypotenuse, or longest side, is always the rhumb that the ship sails upon.

The perpendicular is the difference of latitude counted on the meridian, and the base the departure; which is easting or westing, counted from the meridian.

The angle opposite the base is the course or angle that the ship makes with the meridian; and the angle opposite the perpendicular is the complement of the course, which being taken together, make always eight points or rhumbs, which is 90 degrees.

In constructing figures relating to a ship's course, let the upper part, on what the figure is drawn upon, always represent the north; the lower part south; the right hand east; and the left west.

Draw the north and south line to represent the meridian of the place the ship sails from; then, if the ship's course is to the southward, take the upper end of the line for the place sailed from; but, if the course is northward, take the lower end for that place.

When the course is easterly, describe the arch, and lay off the course and departure on the right-hand side of the meridian; but when westerly, on the left-hand side.

When the course is given in degrees, the degrees expressing it must be taken from the line of chords; but when in points, from the line of rhumbs; and is always to be laid off upon the arch, beginning at the meridian.

When the course is given in points, it may be set down with its corresponding logarithm in the calculation, as found in Table III. of the logarithms, without reducing it into degrees.

In all cases, wherever the complement of the course, or co-sine, &c. is used, the degrees or points put down are the course itself; yet the logarithm belonging to the complement, or co-sine, &c. of that course is taken.

CASE I.

Course and Distance sailed given, to find the Difference of Latitude and Departure from the Meridian.

A ship from the Lizard, in lat. 49° 57′ N. sails S. W. by W. 488 miles.

Required the latitude she is in, and her departure from the meridian she sailed from.

BY CONSTRUCTION.

Draw the line CA to represent the meridian of the Lizard, and C the Lizard point.

With the chord of 60° in your compasses, and one foot in C, describe the compass N. W. S. E.

Take 5 points in your compasses from the line of rhumbs on the plane scale, and set it off on the arch from S. towards W. for the course; draw the line CB, which make equal to the dist. 488; draw BA parallel to E. and W. to cut the meridian in A.

Then will AC be the difference of latitude 271,1, and AB the departure 405,8.

By making the Distance Radius, it will be by Axiom I.:

The course 5 points = 56° 15′

To find the Departure.

As radius 90°	0.00000
Is to the dist. 488	2.68842
So is the sine cou. 5 pts	9.91985
To the dep. 405.8	2.60827

The com. course 3 points = 33° 4,5

To find the Diff. of Latitude.

As radius 90°	0.00000
Is to the dist. 488	2.68842
So is co-sine cou. 5 pts.	9.74474
To the diff. of lat. 271.1	2.43316

Now as the ship is in north latitude sailing southerly, from the latitude left — — 49° 57′ N.

Take the diff. of lat. 271.1 ÷ 60 = 4 31 S.

Gives the lat. in 45 26 N.

And the departure from the meridian is 405.8 miles.

To render the following work more easy, and that the Learner, by being initiated in this other method, will be the better able to understand many things in the following work (as well as in several modern authors), where the proportion of opposite sides, and opposite angles, do not appear, and where radius is not introduced;

Observe—In the description of the logarithm (p. 22) you are shown, that by adding the logarithm of two numbers together, their sum produces the same number in the logarithms, as the product of the same two numbers when multiplied. And by subtracting the logarithm of two numbers from each other, the remaining logarithm produces the same number as the quotient of the same number; or the complement arithmetic (p. 28) of the loga-

rithm of the divisor, added to the logarithm of the dividend, rejecting (radius or) 10 in the index (p. 35), the result is the very same. Again, when the proportion begins with a sine or a co sine, the complement arithmetic added to the other two terms, their sum rejecting 10 in the index will be the logarithm of the number sought.

Now as the logarithm co-secant of any angle is equal to the complement arithmetic of the logarithm sine of that angle, and the logarithm secant is equal to the arithmetic complement of the logarithm co-sine of that angle; omitting radius, therefore, the co-ar. may be taken out of the tables by inspection.

Here all the three sides may be made radius, to find the difference of latitude and departure; therefore, the Learner may make which side he pleases radius; but as for my part I shall make the first, where the distance is made radius, whenever the course is given.

Though this method of working by logarithms is certain, yet the same may be wrought by Gunter's Scale and Compasses, and by several other methods.

NOTE.—When the course is given in points, make use of the line marked sine rhumbs, and Tang. rhum. on the upper Side of the scale; when in degrees, make use of the line marked Sine and Tang.

BY GUNTER.

Now to perform the last case, extend from rad. or 8 points to 5 points on the line marked SR; that extent will reach from the dist. 488 to the dep. 405.8 on the line of num.

2dly. Extend from rad. or 8 points to 3 points (the comp. of the cou. on the line SR); that extent will reach from the dist. 488 to the diff. of lat. 271 on the line of numbers.

Thus may all the operations be performed in the several cases of Navigation.

By this case is calculated the Table of Latitude and Departure for every degree, point, and quarter point of the Mariner's Compass, to the dist. of 300 miles, which is of excellent use in working days' works at sea, and may be applied both to middle latitude and Mercator's sailing, as shall be shown hereafter; we shall only proceed now to the working of the last case by the Table of Diff. of Latitude and Departure.

BY INSPECTION.

Find the given cou. at the top or bottom of the tables, either among the points or degrees, and in that page, and right against the dist. taken in its column, stand the diff. of lat. and dep. in their columns.

Thus the cou. is S. W. by W. or five points, which is found at the bottom of the Table of Diff. of Lat. and Dep. for points: and as the dist. 488 is too great to be found in the Tables, divide it by 2

(or any other convenient number) and that gives 244, which look for in the dist. column, and right against it stands 135.5 for the diff. of lat. and 202.9 for the dep.; which being doubled (because divided by 2) gives 271 for the diff. of lat. and 405.8 for the dep. the same as before. Any of these methods will do, but the last is chiefly practised at sea.

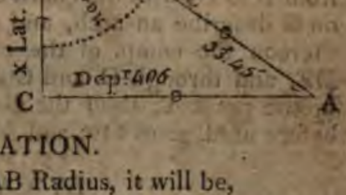
NOTE—All points or degrees above 45, are to be looked for at bottom of Table I. and all less at top; and the miles on the left hand.

CASE II.

Course and Difference of Latitude given, to find the Distance run, and Departure from the Meridian.

If a ship runs S. E. by E. from 1° 45′ north latitude, and then by observation is in 2° 46′ south latitude, what is her distance, and departure?

Now, in this case, as the ship has crossed the Equator, therefore the lat. 1° 45′ N. added to 2° 46′ S. is 4° 31′, which multiplied by 60 gives 271 miles for the diff. of lat.



Constructed the same as Problem X. in Geometry.

Draw BC=271, and BA making an angle with BC=5 points, or 56° 15′; upon C erect the perp. CA to join BA in A, and it is done; then will CA=406, and AB=488.

BY CALCULATION.

By making the Distance AB Radius, it will be,

Course S. E. by E. 5 pts.=56° 15′		Complement 3 points=33° 45′	
To find the Departure.		To find the Distance.	
As co-sine cou. 5pts. co. ar.	0.25526	As co-sine cou. 5pts. co. ar.	0.25526
Is to the diff. of lat. 271	2.43297	Is to the diff. of lat. 271	2.43297
So is sine cou. 5 points	9.91985	So is rad.	10.00000
To the dep. 405.5	2.60808	To the dist. 487.8	2.68823

Hence the ship's dist. run is 487,8 miles, and her dep. from the merid. is 405.6 easterly.

BY GUNTER.

'Extend from 3 to 5 points on the line marked SR, that extent will reach from the diff. of lat. 271 to the dep. 405.6 on the line of numbers.'

2dly. 'Extend from rad. or 8 points to 3 points, that extent will reach from the diff. of lat. 271 to the dist. 488 on the line of numbers.'

BY INSPECTION.

Find the cou. among the points or degrees, and the diff. of lat. in its column, right against which stand the dist. and dep. in their columns.

Now as the diff. of lat. 271 is too great to be found in the Tables, I divide it by 2, and that gives 135,5 which I find over five points in the lat. column; against that stands 244, for the dist. and 202,9 for the dep. which multiplied by 2 gives the dist. 488, and the dep. 405,8.

CASE III.

Course and Departure from the Meridian given, to find the Distance and Difference of Latitude.

If a ship sails N. E. by E. ¾ E. from a port in 3° 15′ south latitude, until she depart from her first meridian 406 miles, I demand her distance, and what latitude she is in.

BY CONSTRUCTION.

Draw the mer. AB, upon which erect the perp. BC, and set off thereon from B her dep. 406 easterly from B to C; with the chord of 60°, on C describe an arch, and set off thereon the comp. of the cou. as DE, and through D and C draw the line CDA, cutting the mer. in the point A; then the dist. AC, measured on the same scale before used, gives 449, and AB 192 the diff. of lat.

BY CALCULATION.

By making the Distance AC radius, it will be,

The course 5¾ points=64° 41′		The compl. 2¼ points=25° 19′	
To find the Diff. of Lat.		To find the Distance.	
As sine cou. 5¾ pts. co. ar.	0.04384	As sine cou. 5¾ pts. co. ar.	0.04384
Is to the dep. 406	2.60853	Is to the dep. 406	2.60853
So is co-sine cou. 5¾ pts.	9.63099	So is rad.	10.00000
To the diff. of lat. 192	2.28336	To the dist. 449.1	265237

From the lat. left — —	3°	15′ S.
Subtract the diff. of lat. 192 miles, or —	3	12 N.
The remainder being 3, shows the ship is in	0	03 S.

BY GUNTER.

'Extend from 5¾ points to 2¼ on the line marked SR, that extent will reach from the dep. 406 to the diff. of lat. 192 on the line of numbers.'

2dly. 'Extend from rad. to $5\frac{1}{4}$ points, that extent will reach from the dep. 406 to the dist. 449 miles.'

BY INSPECTION.

Find the cou. either among the points or degrees, and the dep. in its column; right against which stand the dist. and diff. of lat. in their respective columns.

Thus, with the cou. $5\frac{1}{4}$ points, and half the dep. I find 224.5 for the dist. and 95.8 for the diff. of lat. which being doubled, gives the dist. 449, and the diff of lat. 191.6 nearly as before.

CASE IV.

Distance and Difference of Latitude given, to find the Course and Departure.

Suppose a ship sails 488 miles, between the south and the east, from a port in 2° 52′ south latitude, and then by observation is in 7° 23′ south latitude: what course has she steered, and what departure has she made?

From the latitude by observation 7° 23′, take 2° 52′ the latitude left, the remainder 4° 31′ multiply by 60=271 miles or minutes of difference of latitude.

Constructed as Problem XI. in Geometry.

Draw the mer. AB=271; upon B erect the perp. BC; take 488 in your compasses, and with one foot on A, lay the other on the line BC; join A and C; then will BC be the dep. 406, and the angle BAC the cou.=56° 16′ or 5 points nearly.

To find the Course.

As the dist. 488 co. ar.	7.31158
Is to the rad.	10.00000
So is the diff. lat. 271	0.43297
To co-sine cou. 56° 16′	9.74455

To find the Departure.

As rad.	10.00000
Is to the dist. 488	2.68842
So is sine cou. 56° 16′	9.91993
To the dep. 405.8	2.60835

Hence the cou. is S. E. by E. and the dep. 405,8.

BY GUNTER.

'The extent, from the dist. 488 to the diff. of lat. 271, on the line of numb. will reach from rad. or 90°, to 33° 44′ the co-cou. on the line of sines.

'And the extent, from rad. to 56° 16′ on the line of sines, will reach from the dist. 488 to the dep 405,8 on the line of numbers.'

BY INSPECTION.

Seek in the Tables till against the dist. taken in its column be found the given diff. of lat. in one of the following columns; and adjoining to it stands the dep: which if less than the diff. of lat. the cou. is found at the top; but, if greater, the cou. is found at the bottom.

Now, with half the dist. 244, and half the diff. of lat. 135.5, look in the Tables till they are found to agree in their respective columns, which they do nearly over 5 points; against them stands 202.9 for the dep. which, being doubled, gives 405.8 nearly, as before.

CASE V.

Distance and Departure given, to find the Course and Difference of Latitude.

Admit a ship sails 488 miles between the north and west from the island of Bermuda, in lat. 32° 35′ north, until her dep. is 405 miles; what course has she steered, and what lat. is she in?

NOTE. This case is constructed much the same as the last.

BY CALCULATION.

To find the Course.		To find the Diff. of Lat.	
As the dist. 488 co. ar.	7.31158	As radius	10.00000
Is to radius	10.00000	Is to the dist. 488	2.68842
So is dep. 405	2.60746	So is co-sine co. 56° 6′	9.74644
To the sine of cou. 56° 6′	9.91904	To the diff. of lat. 272.2	2.43486

Hence the course is N. 56° 6′ W. or N. W. by W. nearly,

To the lat. sailed from 32° 35′, add the diff. of lat. 272, or 4° 32′, gives 37° 07′, the lat. the ship is in.

BY GUNTER.

'Extend from the dist. 488 to the dep. 405 on the line of numbers, that extent will reach from rad. to the cou. 56° 6′ on the line of sines.

2dly. 'Extend from rad. to the comp. of the cou. 33° 54′ on the line of sines, that extent will reach from the dist. 488 to the diff. of lat. 272 on the line of numbers.'

BY INSPECTION.

Seek in the Tables till against the dist. taken in its column, be found the given dep. in one of the following columns; and ad-

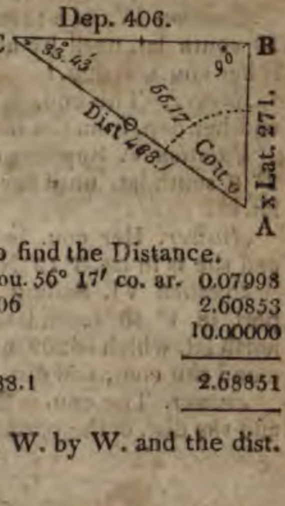
joining to it stands the diff. of lat.: which if greater than the dep. the cou. is found at the top; but if less, the cou. is found at the bottom.

Now, with half the dist. 244, and half the dep. 202,5, I look in the Tables, and find them to agree in their columns, nearly over 5 points, against which is lat. 135,5, which being doubled, is 271, the diff. of lat. nearly, as before.

CASE VI.

Difference of Latitude and Departure given, to find the Course and Distance.

A ship sails between the north and west till her difference of latitude is 271 miles, and her dep. is 406 miles; I demand her course and distance?



Constructed as Problem XII. in Geometry.

Draw AB=271, and perp. to it BC =406; join C and A; then will the angle CAB be the cou. =56° 17′, and AC the dist. =488 miles.

To find the Course.		To find the Distance.	
As the diff. of lat. 271 co. ar.	7.56703	As sin. cou. 56° 17′ co. ar.	0.07998
Is to rad.	10.00000	: Dep. 406	2.60853
So is the dep. 406	2.60853	: : Rad.	10.00000
To the tan. of cou. 56° 17′	10.17556	: Dist. 488.1	2.68851

Hence her cou. is N. 56° 17′ W. or N. W. by W. and the dist. sailed 488.1 miles.

BY GUNTER.

'Extend from the diff. of lat. 271 to the dep. 406 on the line of num. that extent will reach from rad. to 56° 17′ the cou. on the line of tan.

2dly. 'For the dist. we must consider it as rad. (there being no line of sec. on the scale), and extend from rad. or 90° to the cou. 5 points on the line of sines, that extent will reach from the dep. 406, to the dist. 488 on the line of numbers.'

BY INSPECTION.

Seek in the Tables till half the given diff. of lat. 135.5, and dep. 203 are found together in their respective columns; then right against them will be found half the dist. 244, in its column; and the cou. stands in degrees either at the top or bottom of the column where the diff. of lat. and dep. was found, which in this case is over 56° 15′, or 5 points, the cou. required.

The six foregoing Problems are the common cases of Plane Sail-

ing, which the learner ought to be well acquainted with; and for that end I here add six more for practice, whose answers may be found by the foregoing rules:

Question I. A ship in 2° 18′ south lat. sails N. by E. 281 miles: what lat. is she in, and what is her dep.?

Answer. Lat. in 2° 18 N. and dep. 54,82 miles.

Question II. A ship sails S. S. W. from a port in 41° 30′ north lat. and then by observation the said ship is in 36° 57′ north lat. I demand the dist. run and dep.

Answer. Dist. run 295.5 miles, dep. 113.2 miles.

Question III. A ship sails S. S. W. half W. from a port 2° 30′ south lat. until her dep. be 59 leagues; I demand her dist. run and lat. in.

Answer. Dist. run 125.2 leagues, lat. in 8° 1′ south.

Question IV. If a ship sails 360 miles south westward from 21° 59′ south lat. until by observation she be in 24° 49′ south lat. what is her cou. and dep.?

Answer. The cou. is S. W. by W. half W. or S. 61° 49′ W. and her dep. from the mer. is 317.3 miles.

Question V. Suppose a ship sails 354 miles north eastward from 2° 9′ south lat. until her dep. be 150 miles; what is her cou. and lat. in?

Answer. Her cou. is N. 25° 4′ E. or N. N. E. half E. nearly, and she is in lat. 3° 12′ North.

Question VI. Sailing between the north and the west, from a port in 1° 59′ south lat. and then arriving at another port in 4° 8′ north lat. which is 209 miles to the westward of the first port; I demand the cou., and dist. from the first port to the second?

Answer. The cou. is N. 29° 40′ W. or N. N. W.¾ W. nearly; and the dist. of the ports is 422,3 miles, or 140,7 leagues.

TRAVERSE SAILING.

HAVING learned those necessary problems concerning a Single Course, the next is a Compound Course, commonly called a Traverse; in order to the right understanding of which, observe the following definitions:

A Traverse is when a ship, meeting with contrary winds, sails on several courses.

When the wind is directly or partly against a ship's direct course to the place she is bound to, she reaches her port by a kind of Z-like course; which is made by sailing with the wind, first on one side of the ship, and then on the other side.

In a ship, when looking towards the stem, head, or fore-part Starboad signifies the right-hand side;
Larboard or Port the left-hand side;

Aft or Abaft is towards the hinder part, or stern;

The Beam signifies athwart or across the middle of the ship.

When the ship sails the same way the wind blows, she is said to sail or run before the wind; and the wind is right aft, or right astern; and her course is then 16 points from the wind.

When a ship sails with the wind blowing directly across her, she is said to have the wind on the beam; and her course is eight points from the wind.

When the wind blows obliquely across the ship, the wind is said to be abaft the beam, or afore the beam, according as her course is more or less than 8 points from the wind.

When a ship endeavours to sail towards that part of the compass from whence the wind blows, she is said to sail on a wind, or to ply to windward, or close-hauled, or on a bowling.

A vessel sailing as near as she can to the point from whence the wind blows, is said to be close-hauled. The generality of ships will lie within about 6 points of the wind, but sloops and other vessels will lie much nearer.

The Windward, or Weather-side, is that side of the ship on which the wind blows; and the other is called the Leeward or Lee-side.

Tacks and Sheets are large ropes made fast to the lower corners of the fore and main sails, by which either of these corners are hauled fore and aft.

When a ship sails by or on a wind, the windward tacks are always hauled forwards, and leeward or lee-sheets aft.

The starboard tacks are aboard when the starboard side is to windward, and the larboard to leeward; and the larboard tacks are aboard when the larboard side is to windward and the starboard to leeward: either tacks, the yards are braced up.

To know how near the wind a ship will lie, observe the course she goes on each tack when she is close-hauled, then half the number of points between the two courses will show how near the wind that ship will lie.

The most common cases, in turning to windward, may be constructed by the following precepts:—

Having drawn the meridian, or north and south, and parallel of latitude (or east and west line), in a circle representing the horizon of the place, mark, in the circumference, the place of the wind; draw the rhumb, passing through the place bound to, and lay thereon the distance of that place from the centre.

On each side of the wind lay off in the circumference the points, or degrees showing how near the wind the ship can lie, and draw the rhumbs.

Now, the first course will be on one of those rhumbs, according to the tack the ship leads with; draw a line through the place bound to, parallel to the other point, to meet with the first, and this will show the course and distance on the other tack.

To resolve a Traverse, is to reduce and bring several courses into one; the courses are known by the compass, and the distances by the log, which in common voyages is hove once in two hours, but in ships of war, or in East-Indiamen, every hour.

In the steerage, or some convenient place in the ship, there is generally kept a table, called the log-board, divided into seven columns; in the first is written the hours of the day, in the second, the knots the ship runs during half a minute; each of these knots bears the same proportion to a sea mile, that half a minute does to an hour; consequently, so many knots as the ship runs in half a minute (the time allowed for trying the experiment), so many miles she runs in an hour. In the third the fathoms, 10 of which ought to make a knot; in the fourth the courses steered by the compass; in the fifth the winds; in the sixth the lee-way, or how far the ship is drove to the lee-ward of the course steered by the compass; in the seventh the transactions of the day, as in the following Table. Every day at noon the contents are transcribed into the log-book, which is divided into columns, exactly like the log-board, and the several courses being corrected by allowing for the lee-way and variations, and the distance run upon each being set down in a Traverse-table, shows what difference of latitude and departure the ship has made during the last 24 hours; and from thence is found the latitude and longitude the ship is in, &c. This operation is called doing a day's work.

THE LOG-BOARD.

H.	K.	F.	Courses.	Winds.	Lee-way.	Transactions.
2	6		S. W. by S.	N.		
4	5	5				
6	5			N. W.		
8	5					
10	4	5	N. E.	N. N. W.		Moderate gales
12	4	5				& fair weather,
2	4	5				at 8 A. M. saw
4	4	5				a ship to the
6	4	5				northward.
8	5					
10	4	5	S. W. by S.	W. N. W.		No observa-
12	4					tion.

Having placed the several courses and distances run upon each, begin with the first course S. W. by S. which is 3 points, and the distance run upon it being summed up, is 21.5, or an half, which *being doubled* (because the log is hove every two hours) is 43. In

like manner proceed with the other course, and then find the diff. of lat. and dep. for each cou. and dist.

When the cou. is to the southward, the diff. of lat. must be set in the column marked S., but if to the northward, in that marked N.: likewise, when the course is to the eastward, the dep. must be set in the column marked E.; but if to the westward, in that marked W. Thus the first course being S. W. by S. 3 points, the diff. of lat. belonging to it is set under S. and the dep. under W. as in the following table:—

TRAVERSE TABLE.

COURSES.	DIST.	N.	S.	E.	W.
S. W. by S.	43		35.8		23.9
N. E.	45	31.8		31.8	
S, W. by S.	27		22.4		15.0
		31.8	58.2	31.8	38.9
			31.8		31.8
		D. Lat.	26.4 S.	Dep. W.	7.1

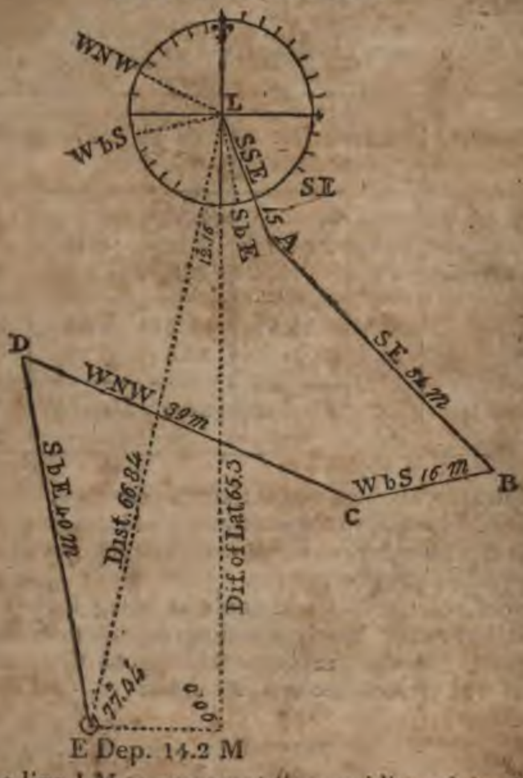
Here the westings being greater than the eastings, the diff. shews how far the ship has got to the westward; and the southings being greater than the northings show how far she has got to the southward of the place she set out from.

Now the diff. of lat 26.4 and dep. 7.1 being looked for in the Tables, will be found nearly standing together under 15° and against dist. 27. Hence the course made good upon the several courses is S. 15° W. and the dist. 27 miles.

EXAMPLE I.

Suppose a ship takes her departure from the Lizard in latitude 49° 57′ N. it bearing N. N. W. distance, by estimation, 5 leagues, sails S. E. 34, W. by S. 16, W. N. W. 39, and S. by E. 40 miles; required the latitude she is in, and her bearing and distance from the Lizard?

BY CONSTRUCTION



Draw the line LM to represent the meridian of the Lizard, and L to Lizard point; on L describe the compass; then set off the opposite point to the bearing of the Lizard; the S. S. E. line L A, which make equal to 15 miles; parallel to the S. E. line draw the line AB equal to 34 miles; again, from B parallel to W. by S. draw BC equal to 16 miles; next, through C, draw a line parallel to W. N. W. which make equal to 39 miles; from D draw DE, parallel to the S. by E. line, equal to 40 miles; then is E the place of the ship at the end of her several courses, EL the distance, LM the diff. of lat. EM her departure, and the angle ELM the course she has made good.

To find the same by CALCULATION.

For the First Course, S. S. E. 15 Miles.

To find the Diff. of Lat.		For Departure.	
As rad. 90°	10.00000	As rad. 90°	10.00000
Is to dist. 15	1.17609	Is to dist. 15	1.17609
So is co-sine cou. 2 pts.	9.96562	So is sine. cou. 2 pts.	9.58284
To diff. lat. 13.9	1.14171	To dep. 5.7	0.75893

Second Course S. E. 34 Miles.

For Difference of Latitude.		For Departure.	
As rad. 90°.	10.00000	As rad. 90°	10.00000
Is to co-sine cou. 45°	9.84948	Is to sine cou. 45°	9.84948
So is dist. 34	1.53148	So is dist. 34	1.53148
To diff. lat. 24	1.38096	To dep. 24	1.38096

Third Course W. by S. 16 Miles.

For Difference of Latitude.		For Departure.	
As rad. 90°	10.00000	As rad. 90°	10.00000
Is to co-sine cou. 78° 45′	9.29024	Is to sine cou. 78° 45′	9.99157
So is dist. 16	1.20412	So is dist. 16	1.20412
To diff. lat. 3.1	0.49436	To dep. 15.7	1.19569

Fourth Course W. N. W. 39 Miles.

For Difference of Latitude.		For Departure.	
As rad. 90°	10.00000	As rad. 90°	10.00000
Is to co-sine cou. 67 30′	9.58284	Is to sine cou. 67° 30′	9.96562
So is dist. 39	1.59106	So is dist. 39	1.59106
To diff. lat. 14.9	1.17390	To dep. 36	1.55668

Fifth Course S. by E. 40 Miles.

For Difference of Latitude.		For Departure.	
As rad. 90°	10.00000	As rad. 90°	10.00000
Is to co-sine cou. 11° 15′	9.99157	Is to sine cou. 11° 15′	929024
So is dist. 40	1.60206	So is the dist. 40	1.60206
To diff. lat. 39.2	1.59363	To the dep. 7.8	0.89230

Though this method of finding the diff. of lat. and dep. by logarithms is certain, yet the same may be more readily found by the Tables of Diff. of Lat. and Dep.; that is, to find the diff. of lat.

for each course and dist. by inspection, and placing t
n the following TRAVERSE TABLE:—

RSES.	DIST.	DIFF. LAT. N.	DIFF. LAT. S.	DEPARTURE. E.	DEPARTURE. W.
S E.	15		18.9	5.7	
E.	34		24.0	24.0	
by S.	16		3.1		15.7
N. W.	39	14.9			36.0
y E.	40		39.2	7.8	
sum	—	14.9	80.2	37.5	51.7
e	—	—	14.9		37.5
		—	65.3		14.2

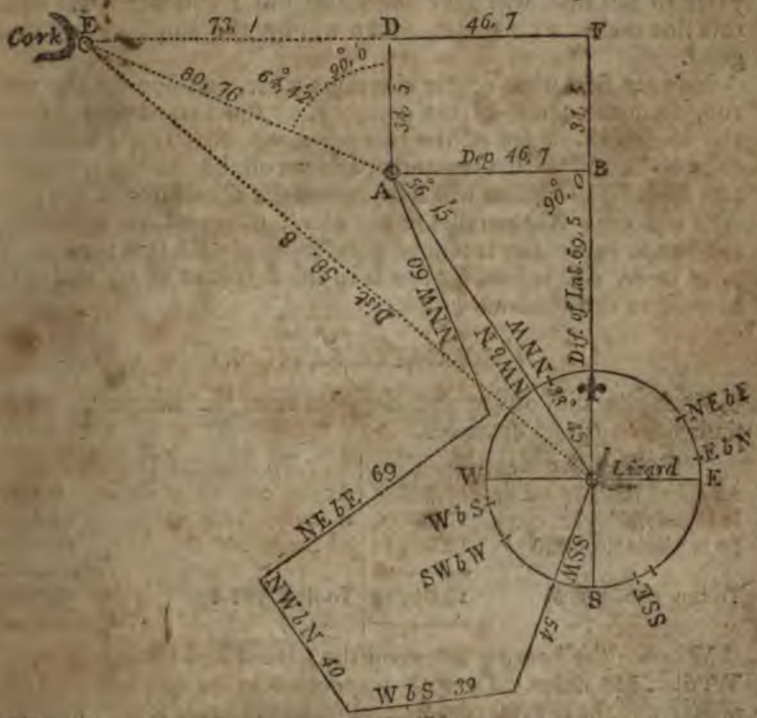
placed them as above, add up all the westings, easti
and southings separately, and set down their respec
e bottom of each column; and as the westing is gre
asting, subtract the easting therefrom, and the diff.
the ship's dep. is so much west of her first meridia
the southing being greater than the northing, subt

40, N. E. by E. 69, and N. N. W. 60 miles; I demand the direct cou. dist. diff. of lat. and dep. made good upon the several courses, with the lat. she is in, and what course she must afterwards steer, and how far, to gain her intended port.

BY PROJECTION.

Latitude of Cork	51° 41′
Latitude of Lizard	49 57
	1 44

Difference of latitude . . . . 104 Departure 120



With the chord of 60° describe a circle, though which draw the mer. north and south, and crossing that at right angles, draw the east and west points; the centre represents the Lizard; then set off two points from the south westerly; though which draw a line to the centre for the first cou. S. S. W. upon that set off the first dist. run 54 miles, which is the ship's place at the end of her first course.

Draw the W. by S. rhumb; and parallel to it a line, passing through the ship's last place; and upon it set off 39 for the second dist.; draw the N. W. by N. rhumb; and parallel to it, as before,

draw a line, passing through the ship's last place; upon it set off 40, and that will be the place of the ship at the end of her third cou.; then draw the N. E. by E. rhumb; and parallel to it a line, passing through the ship's last place; and upon it set off 69 for the fourth dist.; then draw a N. N. W. rhumb; and parallel to it a line as before, through the ship's last place: and upon it set off the last dist. 60, which is the ship's place at the end of her several courses; from which draw a line parallel to the east and west line, until it cuts the mer.; for the whole dep. from this to the centre, being measured on the same scale, will give her diff. of lat. made good upon the several courses; and a line drawn from the ship's last place to her first, will give the whole dist.; and the angle which this line makes with the meridian will be the ship's course made good.

Now, to find what course she must steer, and how far she must run, from the centre of the compass, or the Lizard point, set off the whole diff. of lat. of the two ports, viz. 104, to F; through F draw an E. and W. line westerly, and set off thereon the whole dep. 120 from F to E; then will E represent the situation of Cork; join AE, and draw AD parallel to the mer.; then will AE be the dist. she has to run to her intended port, the angle EAD is the cou. she must steer, ED is how far she is to the eastward of it, and AD is how far to the southward of it.

BY CALCULATION.

With the diff. of lat. and dep. between the two ports, to find their bearings and distances.

To find the Bearing.		To find the Distances.	
As diff of lat. 104 co. ar.	7.98297	As sine cou. 49° 5′ co. ar.	0.12167
Is to rad. 90°	10.00000	Is to dep. 120	2.07918
So is whole dep. 120	2.07918	So is rad. 90°	10.00000
To tan. cou. 49° 5′	10.06215	To dist. 158.8.	2.20085

Whence the bearing between the Lizard and Cork is N. 49° 5′ W. dist. 159 miles. Or with inspection to be 49°, and dist. 159 miles; and the several courses and distances being found, will stand as in the following

TRAVERSE TABLE.

COURSES.	DIST.	DIFF. LAT. N.	DIFF. LAT. S.	DEPARTURE. E.	DEPARTURE. W.
S. S. W.	54	....	49. 9	....	20. 7
W. by S.	39	....	7. 6	....	38. 3
N. W. by N.	40	33. 3	....	....	22. 2
N. E. by E.	69	38. 3	....	57. 4	....
N. N. W.	60	55. 4	....	....	23. 0
From		127. 0	57. 5	57. 4	104. 2
Take		57. 5	....	....	57. 4
Remains		69. 5	....	....	46. 8

To find her direct Course and Distance made good.

To find the Course.			To find the Dist.		
As diff. of lat. 69.5 co. ar.		8.15802	As rad.		10.00000
Is to rad. tan.	45°	10.00000	To diff. lat.	69. 5	1.84198
So is dep.	46.8	1.67025	So is sec. cou. 33° 57′		10.08117
To tan. cou. 33° 57′		9.82827	To dist. 83.78		1.92315

Or, with the proper diff. of lat. 69.5 and the dep. 46.8, look in the tables of diff. of lat. and dep. the nearest numbers corresponding to these are 69.6 and 47 under 34° against dist. 84.

To find the Bearing and Distance to the intended Port.

	° ′	In Angle A E D.	
Lizard's lat.	49.57 N	From whose diff. lat. ports	104
Add diff. lat.	1. 9 N	Subtract ship's northing	69.5
Ship's latitude in	51. 6 N	Remains ship's southw. of port	34.5

From whole Dep. subtract Ship's Dep. 120—47=73 ED.

As diff. of lat. 34.5 co. ar.		8,46218	As sine cou. 64° 42′ co. ar.		0.04379
Is to rad. tan. 45°		10.00000	Is to dep.	73	1.86332
So is dep.	73	1.86332	So is rad.	90	10.00000
To tan. cou. 64° 42′		10.32550	To dist.	80.74	1.90711

Whence the cou. she must steer is N. 64° 42′ W. or N. W. by W. ¾ W. dist. 81 miles.

Or, with the diff. of lat. 34. 5 and dep. 73, look into the Tables.

the nearest num. to these are 73.4 and 34.2 standing over 65 against dist. 81.

All the preceding may be found by Gunter's Scale, but shall leave the working of them to exercise the Learner, who ought to be well acquainted with Traverse Sailing; and for that purpose it has been thought proper to subjoin the following, which is the most general and useful that well can be, and may be worked by any of the foregoing methods.

A ship being at sea in lat. 37° 10′ N. is bound to a port, which lies to the westward in lat. 33° 0′ N. The dep. between the ship and the place is 180 miles; consequently, by Case VI. the course will be S. W. by S. 2 degrees westerly, and dist. 308 miles, but the wind being variable, is obliged to ply upon these several courses, the dist. run upon each being obtained by the log; and the first she sails (with her larboard tacks on board) S. W. by W. 27 miles, W. S. W. half W. 30 miles, W. by S. 25 miles, W. by N. 18 miles.

(Starboard tacks on board wind shifting) S. S. E. 32 miles, S. S. E. three quarters E. 27 miles, S. by E. 25 miles, S. 31 miles, S. S. E. 39 miles.

Required the lat. the ship is in, and her dep. from the mer.; upon what course she must steer if possible, and how far she must sail to gain her intended port.

The diff. of lat. and dep. being found by the preceding directions, will stand as in the following Table:—

The ship is in lat. 34° 21′ N. the dep. is 47.4 W.

The cou. made good is S. 15° 38′ W. and dist. 175.9.

The cou. to the intended port is S. 58° 43′ W. or S. W. by W. one quarter west nearly, distance 155.2.

MIDDLE LATITUDE SAILING.

IN Plane Sailing the earth was considered as a plane, representing a bowling-green, having the meridians parallel to each other, and consequently the degrees of longitude equal in all places; but this cannot be true, as the earth is a globe or sphere; for,

As the meridians are circles on the terraqueous globe, meeting in the poles (as may be seen in the Plate page 46), it is obvious, that any two of those circles must recede more at greater distances from the poles; and at equal distances from each pole, or at the equator, the distance between the meridians is greatest.

The true place of a ship at sea depends upon its distance from the equator, and some noted meridian; and since the meridional distance, that is, the distance between any two meridians, varies in every latitude, it is therefore convenient this distance should be reckoned in a fixed latitude, and where the degrees are of the same magnitude with those of the meridian, which can be no where but on the equator, where 60 geographical miles make a degree.

The circumferences of all circles are in direct proportion to each other, as their radii; and since the earth turns once round its axis in 24 hours, every point upon its surface must describe circles parallel to the equator: hence it follows, that the circumference of any parallel of latitude, in miles, is to the circumference of the equator, in miles, as the co-sine of that latitude is to radius; and, that the breadth of a degree, in any parallel of latitude, is to the breadth of a degree upon the equator, as the sine complement of that latitude is to radius.

By the last proportion was the following Table calculated; which shows the breadth of a degree of longitude in every latitude; and may be made to answer for any degrees or minutes by taking proportional parts.

The following Table shows how many Miles answer to a Degree of Longitude at every Degree of Latitude.

D. L.	MILES.	D. L.	MILES.	D. L.	MILES.	D. L.	MILES.	D. L.	MILES.
1	59..99	19	56..73	37	47..92	55	34..41	73	17..54
2	59..96	20	56..38	38	47..28	56	33..55	74	16..53
3	59..92	21	56..01	39	46..62	57	32..68	75	15..52
4	59..86	22	55..63	40	45..95	58	31..79	76	14..51
5	59..77	23	55..23	41	45..28	59	30..90	77	13 .50
6	59..67	24	54..81	42	44..59	60	30..00	78	12..48
7	59..56	25	54..38	43	43..88	61	29..09	79	11..45
8	59..42	26	53..93	44	43..16	62	28..17	80	10..42
9	59..26	27	53..46	45	42..43	63	27..24	81	9..38
10	59..08	28	52..97	46	41..68	64	26..30	82	8..35
11	58..89	29	52..47	47	40..92	65	25..36	83	7..32
12	58..68	30	51..96	48	40..15	66	24..41	84	6..28
13	58..46	31	51..43	49	39..36	67	23..45	85	5..26
14	58..22	32	50..88	50	38..57	68	22..48	86	4..18
15	57..95	33	50..32	51	37..76	69	21..50	87	3..14
16	57..67	34	49..74	52	36..94	70	20..52	88	2..09
17	57..37	35	49..15	53	36..11	71	19..54	89	1..05
18	57..06	36	48..54	54	35..26	72	18..55		

Hence it follows, that

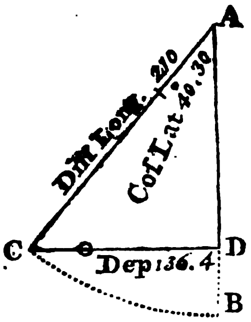
As radius, or sine 90° Is to the diff. of long. in miles, So is co-sine of any paral. of lat. To the dist. in miles between any two mer. in that paral. of lat.	AND,	As co-sine of any paral. of lat. Is to the distance run in miles in that lat. So is the radius, or sine of 90° To the diff. of long. in miles.

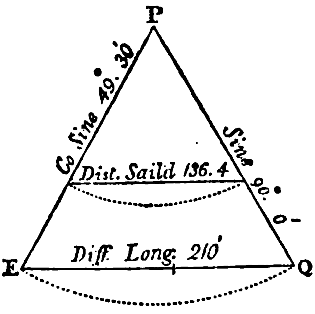
From what has been said, arises the solution of the following Problems.

PROBLEM I.

The Difference of Longitude between two Places, both in one Parallel of Latitude, being given, to find the Distance between them.

Suppose a ship in the lat. 49° 30′ N. or S. sails directly E. or W. until her diff. of long. be 3° 30′, and the dist. sailed be required.





BY PROJECTION.

With the sine of 90° in your compasses, taken from the Plane Scale, and with one foot in P, describe the arch EQ, and upon it set off the diff. of long. 210 miles, and draw the lines PE and PQ to represent the two meridians; and then EQ represents the equator, and P the pole. Again, with the sine com. of the lat. 49° 30′, *viz.* 40° 30′ in your compasses, taken from the line of sines on the Plane Scale, and with one foot in P, describe an arch, and the dist. between the points, where it cuts the two meridians, being measured upon the same scale of equal parts that the diff. of long. was, will be the dep. 136.4 miles.

Or, thus:—

Draw the mer. AB, and with the chord of 60° in your compasses describe an arch, and upon it set off the comp. of the lat. 40° 30′ (taken from the line of chords), and set it off upon the arch as a cou. in Plane Sailing, and draw the line AC as a dist. which make equal to the diff. of long. 210 miles; then will the departure CD be the distance 136.4 miles as before: this last method is preferable to the former, as we are not confined to any particular scale.

Reverse this Problem, and suppose the dist. sailed in any parallel of lat. given, to find the diff. of long.

With the sine com. of lat. in your compasses describe an arch, upon which set off the dep. 136.4 miles, and through the points where it cuts the arch draw the lines PE and PQ; then, with the sine of 90° in your compasses, and one foot in the former centre P, describe an arch to cut PE and PQ; then EQ being measured upon the small scale of equal parts that the dep. was, will be the diff. of long. 210 miles.

BY CALCULATION.

To find the Departure.

As rad. 90° — —	10.00000
Is to the diff. of long. 210	2.32222
So is co-sine lat. 49° 30′	9.81254
To the dist. or dep. 136.4	2.13476

BY GUNTER.

'The extent from rad. to sine com. lat. 40° 30′ on the line of sines will reach from the diff. of long. 210 to the dist. 136.4 on the line of numbers.'

BY INSPECTION.

Find the sine com. of the lat. among the degrees, and in the dist. column the diff. of long., opposite to which, in the column of dep. is the dist. required; but as the co-lat. is 40° 30′, therefore,

For 40 degrees you will find —	135
For 41 degrees you will find —	137.8
The sum is — —	272.8
Half the dist. required —	136.4

This is done because the Table of Diff. of Lat. and Dep. is calculated only for single degrees.

By the reverse of the last problem, having the dist. run in any parallel to find the diff. of long.

Suppose a ship in lat. 49° 30′ N. or S. sails directly E. or W. 136.4 miles, and her diff. of long. be required.

As co-sine of lat. 49° 30′ co. ar.	0.18746
Is to the dist. 136.4 —	2.12481
So is rad. — —	10.00000
To the diff. of long. 210 —	2.32227

BY INSPECTION.

Look for the comp. of the lat. among the degs. as if it was a cou. and the dep. in its column: right against which stands the diff. of long. in the dist. column. In the last Problem the ship is supposed to have sailed due east or west, in the same parallel of lat.; but in her course she generally crosses several meridians and parallels, and then arrives at a different lat. from that she left; and, as it is plain

by the foregoing Table, that the miles which make a degree in one parallel, will not be the same as those that make a degree in any other parallel, lying on the same side of the equator; therefore add both lats. together, and take half their sum for a mean or mid. lat.; which may be conceived as if the ship had sailed in one lat.; with which the diff. of long. may be turned into dep. and dep. into diff. of long. in the same manner as has been already shown, for it will be

As radius	AND,	As the co-sine of the mid. lat.
Is to the difference of longitude,		Is to the departure,
So is the co-sine of the mid. lat.		So is radius
To the departure.		To the difference of longitude.

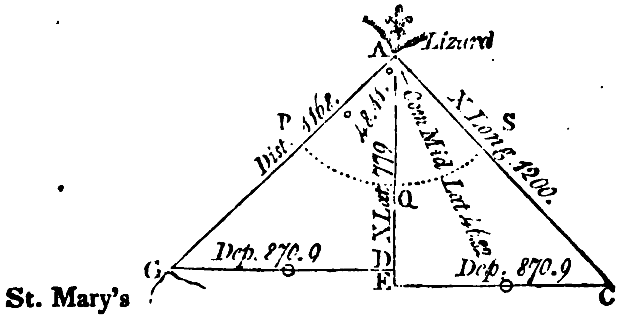
Having the diff. of lat. and dep., the cou. and dist. are found by Case the Sixth, in Plane Sailing.

CASE I.

Required the bearing and dist. between the Lizard, in lat. 49° 57′ N. long. 5° 12′ W. and the island of St. Mary, one of the Western islands, in lat. 36° 58′ N. and long. 25° 12′ W.

Lizard's lat.	49° 57′ N.		49° 57′	Long. 5° 12′ W.
St. Mary's lat.	36 58 N.		36 58	Long. 25 12 W.
	12 59	Sum	2)86 55	20 0
	60			60
		Mid. lat.	43 28	
Diff. in miles	779		90 00	1200 diff. long.
		Co-mid. lat.	46 32	

BY PROJECTION.



Draw the mer. AE, with the chord of 60 describe the arch PS; upon which set off 46° 32′, the comp. of mid. lat. from Q to S; through S draw the line AC=1200, the diff. of long. let fall the perpendicular CE, which will be the dep. 870.9; upon AE set off AD 779, the diff. of lat.; and upon D erect the perp. DG, and

upon it set off the dep. 870.9; join G and A, and it is done; for GA will be the dist. 1168 miles, and the angle GAD the cou. S. 48° 4′ W.

THE CALCULATION.

To find the Departure.		To find the Course.	
As radius	10.00000	As diff. of lat. 779 co. ar.	7.10846
Is to diff. of long. 1200	3.07918	Is to radius Tan. 45°	10.00000
So is co-sine mid. lat. 43° 28′	9.86080	So is dep. 870.9	2.93998
To the dep. 870.9	2.93998	To tang. of cou. 48° 11′	10.04844

To find the Distance.	
As sine cou. 48° 11′ co. ar.	0.12768
Is to deg. 870.9	2.93998
So is radius 90°	10.00000
To the dist. 1168	3.06766

Note. The course may be found without the departure, by Middle Latitude Sailing, thus:

As the diff. of lat. 779 co. ar.	7.10846
Is to the diff. long. 1200	3.07918
So is co-si. mid. lat. 43° 28′	9.86080
To tang. cou. 48° 11′	10.04844

BY GUNTER.

1st. 'The extent from 46° 32′, the comp. of the mid. lat. to rad. on the line of sines, will reach from 1200 to 870.9 on the line of numbers.

2dly. 'The extent from rad. or 90° to 41° 49′ the comp. of the cou. on the line of sines, will reach from 779 to 1168 on the line of numbers.

3dly. 'The extent from 779 to 870.9 on the line of numbers, will reach from 45° to 48° on the line of tangents.'

BY INSPECTION.

Look for the comp. of mid. lat. as if it was a cou. in Plane Sailing, and diff. of long. in the dist. column; opposite to which stands the dep. in its column. Having the diff. of lat. and dep. the cou. and dist. are found as in Case VI. in Plane Sailing.

Thus taking $\frac{1}{4}$ of the diff. of long. 1200=300, and as the comp. of the mid. lat. is 46° 32′, or nearly 46$\frac{1}{2}$, I look over 46 and 47, and against the dist. stands 215.8 and 219.4 in the dep. columns; which, added together, gives 435.2, half is 217.6; this multiplied by 4 gives 870.4 the dep.

Again, taking $\frac{1}{4}$ the diff. of lat. and $\frac{1}{4}$ of the dep. 194.7, and 217.6; the nearest number of these standing together are 216.3 and 194.7 over 48° and against the dist. 291; this, multiplied by 4, gives 1164 miles: hence the cou. is S. 48°. W.; and distance 1164.

CASE II.

Both Latitudes and Departure from the Meridian given, to find the Course and Distance, and Difference of Longitude.

A ship in lat. 49° 57′ N. and long. 5° 24′ W. sails south westerly, till her dep. is 789 miles, and she be in lat. 39° 20′ N.; I demand the cou. dist. and long. she is in.

Latitude left	49° 57′ N.	Latitude left	49° 57′ N.
Latitude in	39 20 N.	Latitude in	39 20 N.
Diff. of latitude	10 37	Sum of latitude	89 17
	60	Middle latitude	44 38
In miles	637		90 00
		Comp. of mid. lat.	45 22

BY PROJECTION.

Draw the mer. AD, from A to D set off the diff. of lat. 637 miles, and on D erect the perp. DG, which make equal to the dep. 789 miles. Draw the line AG, and that will be the dist. 1014 miles, and the angle DAG the cou. 51° 5′.

Again, draw EK parallel to AD, making the dist. from AD equal to the dep. DG 789, on A describe an arch; take the comp. of the mid. lat. 45° 22 in your compasses from the line of chords, and set that off on the arch on the opposite side of the mer. AD: through where that cuts the arch draw the line AE to cut the line KE in E; from E let fall the perp. EB, and it is done; for AE will be the diff. of long. 1109 miles.

BY CALCULATION.

To find the Course it will be,		To find the Distance it will be,	
As the diff. of lat. 637 co. ar.	7.19586	As the sine cou. 51° 5′ co. ar.	0.10899
Is to radius tan. 45°	10.00000	Is to the dep. 789	2.89708
So is dep. 789	2.89708	So is radius 90°	10.00000
To tan. cou. 51° 5	10.09294	To the dist. 1014	3.00607

To find the Difference of Longitude it will be,

As co-sine mid. lat. 44° 38′ co. ar.	0.14775
Is to departure 789 — —	2.89708
So is radius 90 — — —	10.00000
To diff. of long. 1109	3.04483
Long. the ship sailed from	5° 24′ W.
Diff. long. 1109 miles, or ÷ 60 =	18 29 W.
Longitude in —	23 53 W.

BY GUNTER.

1st. 'The extent from the diff. of lat. 637 to the dep. 789 on the line of numbers, will reach from rad. or 45° backward to 51° 5′, the cou. on the line of tangents.

2dly. 'The extent from 51° 5′ to radius or 90° on the line of sines, will reach from the dep. 789 to the dist. 1014 on the line of numbers.

3dly. 'The extent from the comp. of mid. lat. 45° 22′ to rad. or 90° on the line of sines, will reach from the dep. 789, to the diff. of long. 1109 on the line of numbers."

BY INSPECTION.

RULE. With the diff. of lat. and dep. find the cou. and dist. as in Case VI. in Plane Sailing.

2dly. Take the comp. of mid. lat. as a cou. and the dep. in its column, and the dist. corresponding to these will be the diff. of long.

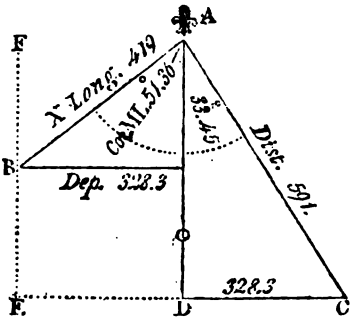
Thus, take a tenth of the diff. of lat. 637, and dep. 789, that is, 63.7 and 78.9, the nearest numbers to these are 63.6 and 78.5 standing together over 51°, against the dist. 101, which multiplied by 10 gives 1010; hence the cou. by inspection, is S. 51° W. and the dist. 1010.

Taking 45° 22′ or 45° as a cou. and a tenth of the dep. 78.9 in its column, the nearest is 78.5, in the dist. column stands 111, which multiplied by 10 gives 1110 for the diff. of long. nearly, as before.

CASE III.

One Latitude, Course and Distance given, to find the Difference of Latitude and Difference of Longitude.

A ship in latitude 42° 30′ N. and longitude 18° 31′ W. sails S. E. by S. 591 miles, or 197 leagues; I demand the latitude and longitude the ship is in.



BY PROJECTION.

As Case I. in Plane Sailing, viz. Draw the mer. AD, and on A describe an arch with the chord of 60°, and upon it set off the course S. E. by S. or 3 points: through where that cuts the arch draw the line AC; making it equal to the dist. 591: from C let fall the perp. CD; then will CD be the dep. 328.3 and AD the diff. of lat. 491 miles.

Draw the line EF parallel to AD, making the dist. from it equal to the dep. CD.

Take the comp. of mid. lat. 51° 36′ from the line of chords in your compasses, and set it off on the arch on the other side of the mer. AD, and through where that cuts the arch draw the line AB to cut the line EF in B, from B let fall a perp. and it is done; for AB will be the diff. of long. 419 miles.

Lat. left		42° 30′ N.	Mid. lat.		38 24
Diff. of lat. 491	=	8 11 S.	Com. mid. lat.		51 36
Lat. in		34 19 N.	Long. left		18° 31′W
Lat. left		42 30	Diff. of long. 419	=	6 59 E.
Sum		2)76 49	Long. in		11 32 W.

From what has been said, it will be easy to construct any of the following cases, as they are constructed the same as in Plane Sailing: only observing that to find the diff. of long. you must take the comp. of mid. lat. as a course in Plane Sailing; with this cou. and the dep. find the dist. and that will be the diff. of long.

To find the same by CALCULATION.

To find the Diff. of Latitude.		To find the Departure.	
As rad. 90°	10.00000	As rad. 90°	10.00000
Is to the distance 591	2.77159	Is to the distance 591	2.77159
So is co-sine course 3 pts.	9.91985	So is sine course 3 pts.	9.74474
To the diff. of lat. 491.4	2.69144	To the dep. 328.3	2.51633

To find the Difference of Longitude.

Without the Departure it will be,		With the Departure it will be,	
As co-si. m. lat. 38° 24′. co. ar.	0.10585	As co-si. m. lat. 38° 24′ co. ar.	0.10585
Is to sine course 3 pts.	9.74474	Is to the dep. 328.3	2.51627
So is distance 591	2.77159	So is rad. 90°	10.00000
To diff. of long. 419=6.59	2.62218	To diff. of long. 419=6° 59	2.62212
		Long. left	18 31 W.

Whence the ship is in lat. 34° 19′ N. and long. 11 32 W.

BY GUNTER.

1st. 'The extent from rad. or 8 points, to the comp. of the cou. 5 points on the line marked SR will reach from the dist. 591 to 491, the diff. of lat. on the line of numbers.

2dly. 'The extent from rad. or 8 points to the cou. 3 points on the line SR will reach from the dist. 591 to the dep. 328 on the line of numbers.

3dly. 'The extent from the sine comp. mid. lat. 51° 36′ to rad. or 90° on the line of sines, will reach from the dep. 328 to the diff. of long. 419 on the line of numbers.'

BY INSPECTION.

Rule. With the cou. and dist. find the diff. of lat. and dep. as in Case I. in Plane Sailing.

2dly. Take the comp. of mid. lat. as a cou. and the dep. in its column, and against it in the dist. column stands the diff. of long.

Thus, under the cou. 3 points, and against a tenth of the dist. 591=59, stand 49.1 and 32.8; these, multiplied by 10, give 491 for the diff. of lat. and 328 for the dep.

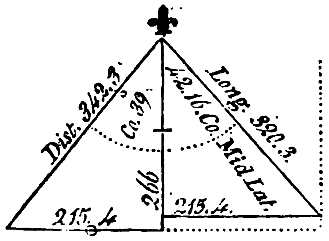
Now, taking the comp. mid. lat. 51° 36′ or 51° as a cou. and a tenth of the dep. 328=32.8 in its column (the nearest is 32.6), against which stands 42 in the dist. column; this multiplied by 10 gives 420, the diff. of long. nearly as before.

If the foregoing directions be well understood, the learner will not find it difficult to work the following cases in Mid. Lat. Sailing.

CASE IV.

Course and Difference of Latitude given, to find the Departure, Distance, and Difference of Longitude.

Suppose a ship sailing from the Lizard, makes, when the variation, lee-way, &c. are allowed for, her course S. 39° W. or S. W. by S. half westerly, and then, by observation, is in lat. 45° 31′ N: what is her dist. run, and long. in?



Lat. of the Lizard	49° 57′ N.	——		49° 57′ N.
Lat. by observation	45 31 N.	——		45 31 N.
Diff. of lat.	4 26 S.	Sum of latitudes		95 28
	60	Mid. lat.		47 44
In miles	266	Co-mid. lat.		42 16

BY CALCULATION.

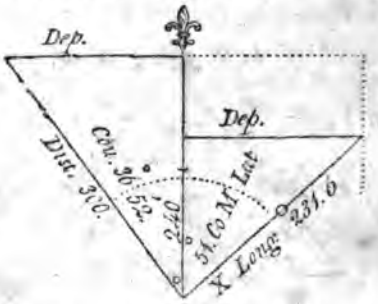
To find the Departure it will be,		To find the Distance it will be,	
As co-sine cou. 39 co. ar.	0.10950	As the co-si. cou. 39° co. ar.	0.10950
Is to the diff. of lat. 266	2.42488	Is to the diff. of lat. 266	2.42488
So is the sine cou. 39°	9.79887	So is rad. 90°	10.00000
To the dep. 215.4	2.33325	To the dist. 342.3	2.53438

To find the Diff. of Longitude.		To find the Longitude in.	
As co-si. of mid. lat. 47° 44′ co. ar.	0.17225	Lizard's long.	5° 12′ W.
Is to the dep. 215.4	2.33325	Diff. of lon. 320 miles or	5 20 W.
So is rad. 90°	10.00000	Long. in	10 32 W.
To the diff. of long. 320.3	2.50550		

CASE V.

Both Latitudes and Distance given, to find the Course and Difference of Longitude.

Suppose a ship runs 300 miles N. westerly, from 37° N. lat. and long. 10° 25′ W. until she be in lat. 41° N.; what is her cou. and long. in?



eft	——	37° 00′ N.	——	37° 00′ N.
n	——	41 00 N.	——	41 00 N.
of lat.		4 00 N.	Sum of lat.	78 00
		60	Mid. lat.	39 00
les	——	240	Co-mid. lat.	51 00

BY CALCULATION.

he Course it will be,		To find the Diff. of Lon. it will	
300 co. ar.	7.52288	As co-si. mid. lat. 39° co. ar.	0.10
0°	10.00000	Is to tang. cou. 36. 52	9.87
lat. 240	2.38021	So is diff. of lat. 240	2.38

To find the Difference of Latitude it will be,			
As sine cou. 6 pts. co. ar.	0.03438	Lat. left	50° 10′ S.
Is to the dep. 957	2.98091	Diff. of lat. 396, or	6 36 S.
So is co-sine cou. 6 pts.	9.58284		
		Lat. in	56 46 S.
To the diff. of lat. 396.4	2.59813		

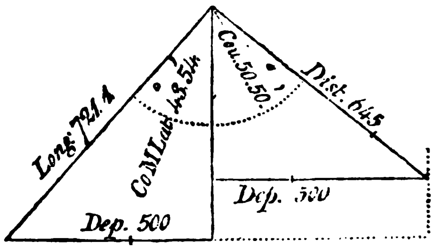
To find the Distance it will be,			
As sine cou. 6 pts. co. ar.	0.03438	Lat. left	50° 10 S.
Is to the departure 957	2.98091	Lat in	56 46
So is radius	10.00000		
		Sum is	2)106 56
To the distance 1036	3 01529		
		Mid. lat.	53 28
		Co-mid. lat.	36 32

To find Diff. of Long. it will be,			
As co-si. m. lat. 53° 28′ co. ar.	0.22527	Long. left is	10 16 E.
Is to the departure 957	2.98091	Diff. of long. 1608, or	26 48 E.
So is radius	10.00000		
		Longitude in	37 4 E.
To mer. diff. of lon. 1608	3.20618		

CASE VII.

One Latitude, Distance sailed, and Departure from the Meridian given, to find the Course, Difference of Latitude, and Difference of Longitude.

A ship in Latitude 49° 30′ N. and longitude 24° 40′ W. sails south eastward 645 miles, until her departure from the meridian be 500 miles: I demand the course steered, and the latitude and longitude the ship is in.



To find the Course it will be,		To find the Diff. of Lat. it will be,	
As the dist. 645 co. ar.	7.19044	As radius	10.00000
Is to the radius	10.00000	Is to the dist. 645	2.80956
So is the departure 500	2.69897	So is co-sine cou. 50° 50′	9.80043
To sine cou. 50° 50′	9.88941	To diff. of lat. 407.3	2.60999

Lat. left is	49° 30' N.	Lat. left	49° 30'
Diff. lat. 407, or	6 47 S.	Lat. in	42 43
Latitude in	42 43 N.	Sum is	2)92 13
		Mid. lat.	46 6
		Co-mid. lat.	43 54

To find the Diff. of Long.			
As co-si. m. lat. 46° 6' co. ar.	0.16901	Longitude left is	24 40 W.
Is to the departure 500	2.69897	Diff. of long. 721, or	12 1 E.
So is radius	10.00000		
		Long. in	12 39 W.
To diff. of long. 721.1	2.85798		

MERCATOR'S SAILING.

PLANE SAILING, as has been before observed, supposes the earth and sea to be in the form of a bowling-green, on which the meridians are parallel, and the degrees of latitude and longitude equal in all places; but the earth and sea compose a round body, or globe, on which the degrees of latitude are equal in all places, and the degrees of longitude decrease from the equator in proportion to the sine-complements of the latitude.

Though the meridians all meet at the poles, and the parallels to the equator continually decrease, and that in proportion to the cosines of their latitudes; yet in old sea-charts the meridians were drawn parallel to each other, and, consequently, the parallels of latitude made equal to the equator, and so a degree of longitude on any parallel, as large as a degree on the equator: also, in these charts, the degrees of latitude were still represented (as they are in themselves) equal to each other, and to those of the equator; by these means the degrees of longitude being increased beyond their just proportion, and the more so the nearer they approached the poles, the degrees of latitude at the same time remaining the same; it is evident places must be very erroneously marked down upon those charts, with respect to their latitude and longitude, and, consequently, their bearings from one another must be very false.

To remedy this inconvenience, so as still to keep the meridians parallel, it is plain we must lengthen the degrees of latitude in the same proportion as those of longitude are, that so the proportion in easting or westing may be the same with that of northing or southing; and, consequently, the bearing of places

from each other to be the same upon the chart as upon the globe itself.

The difficulty in constructing a true sea-chart consists in finding a proper manner of applying the surface of a globe to a plane; which Mr. WRIGHT, an Englishman, by an ingenious conception, happily accomplished.

He conceived the surface of this globe to swell like a bladder while it is blowing up from the equator towards the poles, proportionally in latitude as it does in longitude, until every part of its surface meet that of a concave cylinder impressed on it, whose diameter was equal to the globe's diameter. The equator being thus confined, the parts towards the poles must be extended, both in latitude and longitude, to fill up the cylinder, or figure in the form of a rolling-stone, and impress on its concave surface the lines drawn on the surface of the globe. This cylinder being cut on one of the meridians, from north to south, and laid open, would represent a true sea-chart, the parts of which bear the same proportion to one another as the corresponding parts of the globe do; and on which all the lines will be right lines; having every parallel of latitude on the globe increased till it is equal to the equator; and so the distance of the meridians in these parallels will become equal to their distance at the equator; consequently, the meridians on the chart are expressed by parallel right lines.

Also the meridians being lengthened as the parallels are increased, every degree of latitude is lengthened in the same proportion as the degrees of longitude are increased; therefore, the distance of the parallels of latitude grows wider and wider as they approach the poles.

Mr. GERRARD MERCATOR, a Fleming, in 1556, published a similar chart; but in what manner it was constructed he did not show, neither were those degrees in their true proportion; whence called Mercator's Chart.

Mr. WRIGHT, in 1599, published the Principles of the True Sea-Chart, and how to construct it on the following principles: viz.

That the distance between any two meridians at the equator is in proportion to their distance in any parallel of latitude, as the radius is to the co-sine of that latitude:

That any part of a parallel of latitude is to a like part of the meridian, as the radius is to the secant of that parallel:

And, that the distance of any parallel of latitude from the equator, is equal to the sum of the secants of all the arches between the equator and that parallel.

From these principles, Mr. Wright set about forming a Table, by the continual additions of secants, of all the parallels of latitude, beginning with one minute, which he made radius, and thereto adding the second parallel of 2 minutes, and to the sum of these two, the secant of 3 minutes, &c. The Table thus formed, is that which is commonly called the Table of Meridional Parts, by means

of which a true nautical chart may be constructed, called Mercator's Chart, and all the Cases in WRIGHT's, commonly called Mercator's Sailing, constructed and calculated.

As this Table contains the meridional parts for every degree and minute of the quadrant, from the equator to the poles, it will be easy to find the meridional parts corresponding to any parallel of latitude, as for example:

Required the meridional parts corresponding to the latitude 33° 45'?

Look in the top of the Table for 33°, marked 33d, and in the right or left hand columns, marked (M), under the degree 33, and opposite the minute 45, stands 2153, the meridional parts belonging to 33° 45'.

When the given latitudes are both north or both south, the meridional difference of latitude is found by subtracting the meridional parts of the lesser latitude from those of the greater.

Required the meridional difference of latitude between the Lizard, in latitude 49° 57' N. and the island of St. Mary's, in latitude 36° 58' N.?

The Lizard's latitude	49° 57' N. meridional parts	3470
St. Mary's latitude	36 58 N. meridional parts	2390
	Meridional difference of latitude	1080

When the latitudes are one north, and the other south, the meridional difference of latitude is found, by adding the meridional parts corresponding to both the latitudes together.

Required the meridional difference of latitude between Cape Verd, in latitude 14° 46' N. and the Cape of Good Hope, in latitude 34° 29' S.

Cape Verd's latitude	14° 46' N. meridional parts	896
Cape of Good Hope's	34 29 S. meridional parts	2207
	Meridional difference of latitude	3103

The several cases in Mercator's Sailing are worked by geometry, trigonometry, Gunter's Scale, and the Tables of difference of latitude and departure, exactly in the same manner as those in Plane Sailing, by only considering the meridional difference of latitude as if it were the proper difference of latitude, and the difference of longitude as the departure: for it is no more than enlarging the proper difference of latitude, so as to be equal to the meridional difference of latitude; then will the difference of longitude bear the same proportion to the departure, that the meridional difference of latitude does to the proper difference of latitude; for, in the following figure (which is the first case in Mercator's Sailing),

Let MT represent the meridional and ML the proper difference of latitude, TH the difference of longitude, LO the departure, MO the distance, and the angle TMH, or LMO, the course; then will ML be in proportion to LO, as MT is to TH; and the contrary.

Wherefore, as the proper difference of latitude is to the departure, so is the meridional difference of latitude to the difference of longitude; and

As the meridional difference of latitude is to the difference of longitude, so is the proper difference of latitude to the departure.

Since lengthening or shortening the sides of a triangle does not alter the angles, the departure may be reduced into difference of longitude, and the difference of longitude into departure.

In all the cases (save the first) in Mercator's Sailing, the course, distance, difference of latitude and departure, are found in the same manner as those in Plane Sailing; and then the difference of longitude may be found by either of the following proportions, viz.

(See the Figure in the next page.)

By making the enlarged Distance MH radius, it will be,		By making meridional Difference of Lat. MT radius, it will be
As the co-sine of the course Is to the merid. diff. of latitude, So is the sine of the course To the difference of longitude;	OR	As radius Is to the merid. diff. of latitude, So is the tangent of the course To the difference of longitude.

But in the first Case, it will be

As the merid. diff. of lat. MT Is to radius, So is the diff. of longitude TH To the tangent of the course;	AND	As radius Is to the proper diff. of lat. ML, So is the secant of the course To the distance MO.

Or, when the course is found, you may say, As the co-sine of course is to the proper difference of latitude, so is radius to the distance.

CASE I.

The Latitudes and Longitudes of two Places given, to find the direct Course and Distance between them.

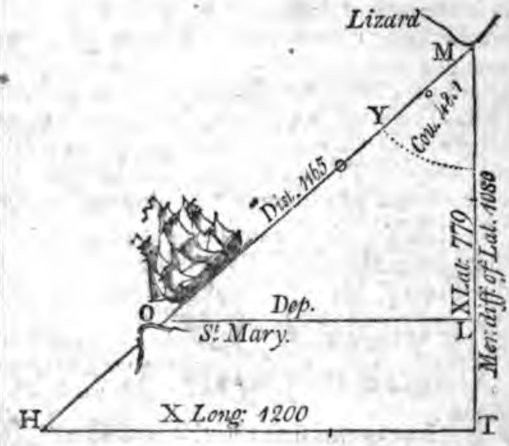
Required the bearing and distance between the Lizard, in latitude 49^0 57′, longitude 5^0 12′ W., and the island of St. Mary, one of the Western Islands, in latitude 36^0 58′ N. and long. 25^0 12′ W.

Lizard's lat.	49^0 57′ N.	meridional parts 3470	long.	5^0 12′ W.
St. Mary's	36 58 N.	meridional parts 2390	long.	25 12 W.
Diff. of lat.	12 59=779	Mer. Diff. Lat. 1080	Diff.	20. 00=1200
	60			60
	779 miles		Diff. long.	1200 miles.

Draw the mer. MT=1080, the meridional difference of lat. and MI=779, the proper diff. of lat.; perp. to MT, draw TH and LO, make TH 1200 miles, the diff. of long.; join H and M; then will the angle TMH be the cou. S. 48^0 01′ W. and OM the dist. 1165 miles.

N

BY PROJECTION.



BY CALCULATION.

the Course, it will be,	To find the distance, it will
of l. 1080, co. ar. 6.96658	As co-si. cou. 48.1. co. ar. 0.17
0° 10.00000	Is to p. diff. lat. 779 2.89

2. Now $\frac{1}{10}$ of the meridional diff. of lat. and the $\frac{1}{10}$ diff. of the longitude are 108,0 and 120,0; the nearest numbers in the Tables are 107,7 and 119,6 standing together over 48°.

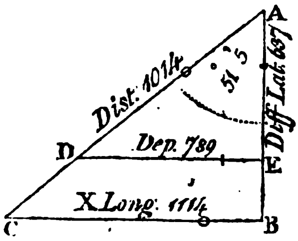
In the latitude column I look for $\frac{1}{10}$, the proper diff. of lat. which is 77,9 the nearest is 77,6, against this stands 116 in the dist. column, which multiplied by 10 gives 1160, nearly the same as that found by calculation.

CASE II.

Both Latitude and the Departure from the Meridian given, to find the Course, Distance, and Difference of Longitude.

A ship in lat. 49° 57′ N. and long. 5° 14′ W. sails S. westward, until her departure from the meridian be 789 miles, and then by observation is in the lat. 39° 20′ N. required her course steered, distance run, and longitude in.

Lat left	49°	57′	Merid. parts	3470
Lat. in	39	20	Merid. parts	2571
Diff. of lat.	10	37	Mer. Diff. Lat.	899
	60			
	637 miles			



BY PROJECTION.

With the proper diff. of lat. and dep. project the same as in Case VI. in Plane Sailing; extend the mer. AE to B, and make AB equal to the meridional diff. of lat. and draw a line parallel to the dep. DE; produce the dist. AD to cut this parallel; and CB will be the diff. of long. Hence the angle BAC will be the cou. S. 51° 5 W. DA the dist. 1014, and BC the diff. of long. 1114 miles.

To find the same by CALCULATION.

As p. diff. lat. 637 co. ar.	7.19586	As sine cou. 51° 5′ co. ar.	0.10899
Is to rad. 90	10.00000	Is to dep. 789	2.89708
So is the dep. 789	2.89708	So is rad. 90° 0′	0.00000
To tang. cou. 51° 5′=	10.09294	To the dist. 1014	3.00607
As rad. 90°	10.00000	Longitude left	5° 14′W.
Is to mer. diff. lat. 899	2.95376	Diff. of long. 1114=	18 34 W.
So is tang. cou. 51° 5′	10.09292		
		Longitude in	23 48 W.
To diff. of long. 1114	3.04668		
		Her course is S. 51° 5′ W. and distance 1014 miles.	

NOTE. The diff. of long. may be found by saying, As prop. diff. of lat. : dep. : : merid. diff. of lat. : diff. of long.

BY GUNTER.

1st. 'The extent from diff. lat. 637, to dep. 789, on the line of numbers, will reach from rad. or 45°, to 51° 5', the cou. on the line of tangents.

2dly. 'The extent from rad. to com. cou. 38° 55', on the line of sines, will reach from diff. lat. 637, to 1014, the dist. on the line of numbers.

3dly. 'The extent from co-cou. 38° 55' to sine cou. 51° 5' on the line of sines, will reach from mer. diff. lat. 899, to 1114, the diff. of long. on the line of numbers.'

BY INSPECTION.

The diff. of lat. and dep. being found together in their respective columns will give the cou. among the degrees or points, and the dist. in its column; in the lat. column belonging to the cou. look for the meridional diff. of lat. and against it will stand the diff. of long. in the dep. column.

Now 1 sixth of diff. of lat. and of dep. are 106,1 and 131.5: the nearest numbers to these are 106.4 and 131.3, standing together over 51° the cou. and against dist. 169; this, multiplied by 6, gives 1014 the dist.

Again, over 51° look for 1-tenth of mer. diff. of lat. 89.9 in the lat. column, the nearest is 90.0, and against which stand 111,1 in the dep. column; this, multiplied by 10, gives 1111 for the diff. of long.

CASE III.

from A to E take the mer. diff. of lat. 396 in your compasses, and with one foot in A, the ship's place, as before, lay the other upon the mer. at B; and upon these two points raise the perp. DE and CB; a line drawn from the ship's place, making an angle with the mer. equal to 39°, the ship's cou. will cut the two perps. at D and C; the first will be the dep. which terminates the dist. AD 342, and the other will be the diff. of long CB=321 miles.

From what has been said, it is plain, that any case in Mercator's Sailing may be projected as a right-angled triangle, by only considering the diff. of long. or dep. as the base; the meridional, or proper diff. of lat. as the perp.; the hypotenuse cut by the dep. as dist.; and the angle which that makes with the perp. the cou.; for in all cases in Mercator's Sailing, the meridional diff. of lat. bears the same proportion to the diff. of long. that the proper diff. of lat. does to the dep.

These instructions being well understood, will be sufficient to inform the learner how to construct any of the following cases:

BY CALCULATION.

To find the Distance.		To find the Diff. of Longitude.	
As co-si. cou. 39° co. ar.	0.10950	As the co-si. cou. 39° co. ar.	0.10950
Is to the diff. of lat. 266	2.42488	Is to mer. diff. of lat. 396	2.59770
So is radius .	10.00000	So is sine cou. 39°	9.79887
To the dist. 342,3	2.53438	To dif. lon. 320.7 = 5°21′W.	2.50607

Lizard's longitude left	—	—	5° 12′ W.
Longitude in	—	—	10 33 W.

BY GUNTER.

1st. 'The extent from co-sine cou. 51°, to rad. on the line of sines, will reach from the proper diff. of lat. 266, to the dist. 342.3 on the line of numbers.

2dly. 'The extent from co-sine cou. 51°, to sine cou. 39° on the line of sines, will reach from the mer. diff. of lat. 396, to the diff. of long. 321, on the line of numbers.'

BY INSPECTION.

Under the cou. 39°, and against half the diff. of lat. 133, stands 171 in the dist. column, which being doubled is 342, the dist.; under the same degrees, and in the lat. column, look for half the mer. diff. of lat. 198, against that, in the dep. column, stands 160.5, doubled is 321, the diff. of long. nearly, as before.

CASE IV.

One Latitude, Course, and Distance given, to find the Difference of Latitude, and Difference of Longitude.

A ship in latitude 42° 30′ N. and longitude 18° 31′ W. sails

S.W. by S. 591 miles; I demand the latitude and longitude the ship is in.

To find the Difference of Latitude it will be,

As rad. 90°	10.00000	Lat. left 42° 30′ N.	M. pts { 2822
Is to the distance 591	2.77159	Diff. lat. 491 8 11	2194
So is co-sine cou. 3 pts.	9.91985		
To the diff. of lat. 491.4	12.69144	Lat. in 34 19 N.	M. diff. of lat. 628

To find the Difference of Longitude it will be,

As co-si. co 3 pts. co. ar.	0.08015	Lon. left 18° 31′ W
Is to m. diff. of lat. 628	2.79796	Di. lo. 420=7.00 W.
So is S. cou. 3 pts.	9.74474	
To diff. of lon. 419.6	2.62285	Long. in 25 31 W.

BY GUNTER.

1st. 'The extent from rad. or 5 points, the com. of the cou. on the line marked SR, will reach from the dist. 591, to the diff. of lat. 491,4 on the line of numbers.

2dly. 'The extent from co-cou. 5 points, to the cou. 3 points, on the line marked SR, will reach from the mer. diff. of lat. 628 to the diff. of long. 419.6 on the line of numbers.'

BY INSPECTION.

Under the cou. 3 points, and opposite a tenth of the dist. 59.0 in the lat. column stands 49.1, which multiplied by 10, is 491, the diff. of lat.; then find. ¼ of the mer. diff. of lat. 157, in the lat. column, against which stands 105 in the dep. column, which, multiplied by 4, gives 420, the diff. of long.

CASE V.

Both Latitudes and Distance given, to find the Course and Difference of Longitude.

If a ship runs 300 miles N. westerly from a port in lat. 37° N. and long. 10° 25′ W. until she be in lat 41° N.; required the course steered and long. in.

Lat. left	37 N.	Mer. parts 2393
Lat. in	41 N.	Mer. parts 2702
Diff. lat.	4=240	M. diff. lat. 309 M.

BY CALCULATION.

To find the Course.		To find the Diff. of Long.	
As the dist. 300 co. ar.	7.52288	As co-si. cou. 36° 52′ co. ar.	0.09689
Is to rad. 90°	10.00000	Is to mer. diff. of lat. 309	2.48996
So is pro. diff. of lat. 240	2.38021	So is sine course 36° 52′	9.77812
To the co-sine cou. 36° 52′	9.90309	To the diff. of long. 231.7	2.36497

Longitude left	—	—	10° 25′ W.
Diff. of long. 232, or			3 52 W.
Longitude in	—	—	14 17 W.

BY GUNTER.

1st. 'The extent from the dist. 300, to the proper diff. of lat. 240, on the line of numbers, will reach from rad. or 90°, to 53° 8′, the comp. of the cou. on the line of sines.

2dly. 'The extent from co-cou. 53° 8′, to cou. 36° 52′, on the line of sines, will reach from the mer. diff. of lat. 309, to the diff. of long. 231.7, on the line of numbers.'

BY INSPECTION.

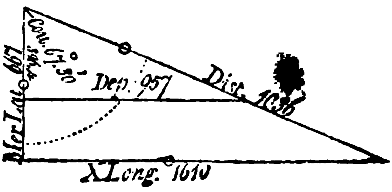
With the dist. and diff. of lat. find the cou. then in the lat. column belonging to this cou. find the mer. diff. of lat.; against which, in the dep. column, will stand the diff. of long.

Thus, half the dist. 150, and half the diff. of lat. 120, will be found standing together in their columns, nearly under 37°, the cou.; and, in the lat. column, find half the mer. diff. of lat. 154.5, the nearest to it is 154.1; against which, in the dep. column, stands 116.1, which doubled is 232.2 the diff. of long. nearly as before.

CASE VI.

One Latitude, Course, and Departure given, to find the Distance, Difference of Latitude, and Difference of Longitude.

A ship sails E. S. E. from a certain port in latitude 50° 10′ S. and longitude 10° 16′ E. until her departure from the meridian be 957 miles; I demand the distance sailed, and the latitude and longitude she is in.



To find the Distance it will be,

As sine cou. 6 pts. co. ar.	0.03438
Is to the dep. 957	2.98091
So is radius	10.00000
To the distance 1036	3.01529

To find the Diff. of Lat. it will be,

As sine cou. 6 pts co. ar.	0.03438
Is to the departure 957	2.98091
So is co-sine cou. 6 pts.	9.58284
To diff. lat. 396=6° 36'	2.59813

To find the Diff. of Long.

As co-sine cou. 6 pts co. ar.	0.41716
Is to mer. diff. of lat. 667	2.82413
So is sine course 6 pts.	9.96562
To diff. of long. 1610	3.20691

Lat. left 50° 10' S. mer. pts.	3490
Lat. in 56 46 S. mer. pts.	4157
Mer. difference lat.	667
Longitude left	10° 16' E.
Diff. of long. 1610 =	26 50 E.
Longitude in	37 6 E.

BY GUNTER.

1st. 'The extent from 6 points to rad. on the line marked SR, will reach from the dep. 957, to the dist. 1036, on the line of numbers.

2dly. 'The extent from 6 points to 2 points on the line marked SR, will reach from the dep. 957, to the diff. of lat. 396, on the line of numbers

3dly. 'The extent from 2 points to 6 points on the line marked SR, will reach from the mer. diff. of lat. 667, to the diff. of long.

To find the Course it will be,

As the distance 645 co. ar.	7.19044
Is to rad.	10.00000
So is the departure 500	2.69897
To sine cou. 50° 50′	9.88941

To find Diff. of Long. it will be,

As co-si. cou. 50° 50′ co. ar.	0.19957
Is to m. diff. of lat. 588	2.76938
So is sine course 50° 50′	9.88948
To diff. lon. 721,8=12° 2′	2.85843
Long. left	14 40 W.
Long. in	2 38 W.

To find the Diff. of Lat. it will be,

As sine cou. 50° 50′ co. ar.	0.11052
Is to the departure 500	2.69897
So is co-sine cou. 50° 50′	9.80043
To diff. lat. 407,3=6° 47′	2.60992

Lat. left 49° 30′ N.	M. pts. 3428
Lat. in 42 43 N.	M. pts. 2840
Mer. diff. lat.	588
As pro. diff. of lat. 407,3 co. ar.	7.39008
Is to departure 500	2.69897
So is m. diff. of lat. 588	2.76938
To diff. of long. 721,8	2.85843

Hence the ship's cou. is S. 50° 50′ E. or S. E. ½ east nearly, and she is in the lat. of 42° 43′ N. and long. 2° 38′ W.

BY GUNTER.

1st. 'The extent from the dist. 645, to the dep. 500 on the line of numbers, will reach from radius to 50° 50′ on the line of sines.

2dly. 'The extent from 50° 50′ to 39° 10′, on the line of sines, will reach from the dep. 500, to the diff. of lat. 407, on the line of numbers.

3dly. 'The extent from 39° 10′ to 50° 50′, on the line of sines, will reach from the mer. diff. of lat. 588, to the diff. of long. 722, on the line of numbers.'

BY INSPECTION.

Now a 5th of the dist. and dep. are 129 and 100, and are found together over 51°; and in the lat. column stands 81.2, which, multiplied by 5, is 406, the diff. of lat.

Then, in the lat. column, seek ¼ of the meridional diff. of lat. 147, the nearest is 146.6; against which in the dep. column, stands 181.1, which, multiplied by 4, is 724.4 the diff. of long.

Having, in the preceding parts, shown how to work the most useful problems in Middle Latitude and Mercator's Sailing; I shall now work the three following cases both by Middle Latitude and Mercator's Sailing, in a manner I generally teach persons who are of age, and youth of good abilities; especially if they are limited to a short time.

rence of Latitude and Departure given, to find the Cou e, and Difference of Longitude, by Middle Latitude or's Sailing.

from latitude of 37° N. and longitude 48° 20′ W. s he north and east, until she be in latitude 51° 15′ N. she has made 564 miles of departure; what was her e, distance run, and longitude in?

37° 0′ N.	Mer. parts	2393
51 15 N.	Mer. parts	3593
14 15=855 miles diff.		1200
)88 15		
		90° 0′
44 7		44 7
		45 53

Comp. mid. lat.

he mer. DP, make it equal to 855 the diff. of lat.; e perp. PN, and make it =564 the dep.; join D and the angle PDN be the cou. N. 33° 25′ E. and DN miles.

dist. of the dep. 564, draw EF parallel to DP; with 60° describe the arch TS, and upon it set off the co d. lat. 45° 53′ from S to T, through T draw DO, and

BY GUNTER.

1st. 'Extend from 855 to 564 on the line of numbers, that extent will reach from rad. or 45°, to 33° 25′ the cou. on the line of tangents.

2dly. 'Extent from rad. or 90°, to the cou. 33° 25′ on the line of sines, that extent will reach from the dep. 564, to the dist. 1024, on the line of numbers.

3dly. 'Extend from rad. or 90°, to the comp. of mid. lat 45° 53′, on the line of sines, that extent will reach from the dep. 564, to 786 miles, the diff. of long. by Mid. Lat. Sailing.

4thly. 'Extend from the sine of the cou. 33° 25′ to the co-sine of the cou. 56° 35′, on the line of sines, that extent will reach from the meridional diff. of lat. 1200 to 792 miles, the diff. of long. by Mercator.

Or, 'The extent from the diff. of lat. 855, to the dep. 564, will reach from the meridional diff. of lat. 1200, to 792, on the line of numbers.'

BY INSPECTION.

With the diff. of lat. and dep. find the cou. and dist. as in Case VI. in Plane Sailing. Take the comp. of mid. lat. as a cou. and the dep. in its column, the corresponding dist. will be the diff. of long. by Mid. Lat. Sailing. And,

Having found the cou. instead of the proper diff. of lat. find the meridional diff. of lat. in the lat. column belonging to the cou.; the corresponding dep. will be the diff. of long. by Mercator's Sailing.

Now, take 1-tenth of the diff. of lat. 1-tenth of the dep. viz. 85.5 and 56.4, the nearest numbers standing together in the Tables to these are 85.5, and 55.5, under 33° against dist. 102, and 85.4, and 57.6 under 34° against dist. 103; now 33° added to 34° is 67°, half is 33° 30′ the cou.; and 102 added to 103 gives 205, half is 102.5, which, multiplied by 10, gives 1025 the dist.

To find the Difference of Longitude.

Over the comp. of mid. lat. 46°, find ¼ of the dep. viz. 141 in its column, and against it stands 196 in the dist. column, this, multiplied by 4, gives 784 miles, the diff. of long. by Mid. Lat. Sailing.,

Again, the cou. being 33° 25′, or nearly 33° ½, look for 1-tenth of meridional diff. of lat.=120 in the lat. columns, under 33° and 34°, the nearest numbers to these are 110.9 and 102.2, the dep. corresponding are 77.9, and 81.1, their sum is 159, half is 79.5, which, multiplied by 10, gives 795, the diff. of long. by Mercator's Sailing, nearly as before.

From what has been said, it is easy to perceive that all the Cases (save the first) in Mid. Lat. and Mercator's Sailing, are projected and worked in the same manner as in Plane Sailing; and

O 2

to obtain the diff. of long. by Mid. Lat. Sailing; the comp. of the mid. lat. is taken as a cou. in Plane Sailing, and with this cou. and the dep. the dist. is found, which will be the diff. of long. by Mid. Lat. Sailing. And having the cou. take the meridional diff. of lat. as if it was the proper diff. of lat. the corresponding dep. will be the diff. of long. by Mercator's Sailing.

The Course and Distance given, to find the Difference of Latitude, and Difference of Longitude.

A ship from the latitude 51° 15′ N. and longitude 9° 50′ W. sails S. W. by S. until she had run 1022 miles, what latitude and longitude is she in?

To find the Departure.		To find the Latitude.	
As rad. 90°	0.00000	As rad. 90°	0.00000
Is to the distance 1022	3.00945	Is to the distance 1022	3.00945
So is sine course 3 pts.	9.74474	So is co-sine course 3 pts.	9.91985
To the departure 567.8	2.75419	To the diff. of lat. 849.8	2.92930

Now 849.8 or 850 divided by 60, gives 14° 10′ S., and being subtracted from the latitude left, leaves 37° 5′ the latitude in: hence the middle latitude is found to be 44° 10′ and meridional difference of latitude 1194. Whence,

To find the Difference of Longitude by Mid. Lat. Sailing.	To find the Difference of Longitude by Mercator's Sailing.

As co-si. cou. 22° 20′ co. ar.	0.03385	As co-si. cou. 22° 20′ co. ar.	0.03386
Is to diff. of lat. 855	2.93197	Is to diff. of lat. 855	2 93197
So is sine course 22° 20′	9.57978	So is radius 90°	0.00000
To the departure 351.3	2.54561	To the distance 924.3	2.96583

To find the Difference of Longitude.

By Mid. Lat. Sailing.		By Mercator's Sailing.	
As co-si. m. lat. 44° 7′ co. ar.	0.14392	As co-si. cou. 22° 20′ co. ar.	0.03386
Is to the departure 351	2.54534	Is to mer. diff. of lat. 1200	3.07918
So is radius 90°	10.00000	So is sine cou. 22° 20′	9.57978
To diff. L. 489=8° 9′ E.	2.68923	To diff. lon. 493=8° 13′	2.69282
Long. left 22 56 W.		Long. left 22 56	
Long. in 14 47 W. by m. lat.		Long. in 14 43 W. by M.	

Case the first in Middle Latitude and Mercator's Sailing, and these three cases, are all that can well happen at sea; but as some young men are inattentive, and frequently looking into the book to see if their calculation is the same as that set down,

The Teacher, perhaps, may find it necessary to let such work the following questions by way of exercise :—

Quest. 1st. Requiring the bearing and distance of Hang. Cliff in Shetland, in lat. 60° 7′ N. and long. 50′ W. and the North Cape of Lapland, in lat. 71° 10′ N. long. 26° 1′ E. ?

Ans. { N. 44° 33′ E. dist. 930.3 miles, by Mercator's Sailing.
N. 45° 4′ E. dist. 938.9 miles, by Mid. Lat. Sailing.

Quest. 2d. A ship in lat. 37° N. and long. 48° 20′ W. sails between the N. and E. until she is in the lat. of 51° 18′ N. and finds she has made 564 miles of dep.; required her direct cou. dist. run, and long. in?

Ans. { N. 33° 38′ E. dist. 1018 miles, long. in 34° 42′ W. by Middle Latitude Sailing.
N. 33° 38′ E. dist. 1018 miles, long. in 35° 9′ by Mercator's Sailing.

Quest. 3d. A ship from the lat. of 51° 22′ N. sails S. S. W. 500 miles; what lat. is she in, and how much has she differed her long. ?

Ans. { Lat. in 44° 9′ N. diff. of long. 267.6 miles, by Mercator's Sailing.
Lat. in 44° 9′ N. diff. of long. 278.9 miles, by Middle Latitude Sailing.

Quest. 4th. A ship from lat. 13° N. sails N. E. by E. until she be in the lat. of 19° 40′ N.; required her dist. run, and diff of long. ?

Ans. { Dist. run 720 miles, diff. of long. 621.1 miles, by Mercator.
Dist. run 720 miles, diff. of long. 623.8 miles, by Mid. Lat.

Quest. 5th. Suppose a ship from the lat. of 45° N. sails between the S. and E. 500 miles, and then her dep. is computed to be 300 miles; required the cou. lat. and diff. of long.?

Ans. { Course S. 36° 52′ E. lat in. 38° 20′ N. diff. of longitude 401.9 by Mercator.
Course S. 36° 52′ E. lat. in 38° 20′ N. diff. of longitude 401.6 by Mid. Lat. }

Quest. 6th. A ship from the lat. 45° 30′ S. sails N. N. W. until her diff. of long. be 7° 40′; required the lat. she is in, and her dist. sailed?

NOTE. This must be worked by Mercator's Sailing, thus:

As the sine cou. 22° 30′ is to the diff. of long. 460, so is the co-sine cou. 22° 30′ to the mer. diff. of lat. 1110. Now, from the mer. parts of lat. left 3073, take the mer. diff. of lat. 1110, the remainder 1963 is the mer. parts of the lat. come to, 31° 4′ S. Having the cou. and proper diff. of lat. the rest is found by Case II. in Plane Sailing.

Ans. The ship is in lat. 31° 4′ S. dist. 937.4 miles.

Quest. 7th. A ship in the lat. 51° 15′ N. and long. 22° W. sails between S. and W. until she has made 564 miles of dep. and 786 miles of diff. of long.; required her cou. dist. lat. and long. in?

Note. This must be worked by Mid. Lat. Sailing, as thus:—

As diff. of long. 786 : rad. : : the dep. 564 : co-sine of mid. lat. 44° 9′, + 44° 9′=88° 18′ the sum lat. and 88° 18′−51° 15′=lat. in 37° 3′ N. Having the diff. of lat. and dep. the cou. is found to be S. 33° 30′ W. and the dist. 1022 miles.

By the several differences of latitudes and departures, found in the Tables of Difference of Latitude and Departure, find the latitudes come to, middle latitudes, and complements of middle latitudes; with each complement of middle latitude and corresponding departure, find the difference of longitude to each course and distance, and set them down in two additional columns, marked difference of longitude east and west, according to the departure used; add up the east and west columns, and their difference will be the whole difference of longitude, by Middle Latitude Sailing.

But if you work by Mercator's Sailing, find the meridional difference of latitude for each course and distance; with each course and meridional difference of latitude, find the difference of longitude; which set down as above directed, and the difference between the east and west columns will be the difference of longitude by Mercator's Sailing. By this method the ship's place may be found at the end of each course and distance run, and pricked off on a Mercator's chart.

EXAMPLE I.

Suppose a ship from the Land's End, in latitude 50° 4′ N. and longitude 5° 41′ 31″.5 W. is bound to the island of St. Mary, in latitude 37° N. and longitude 25° 6′.W. but by reason of contrary winds is obliged to steer the following courses, viz. S. by W. 24 miles; W. S. W. 32, N. W. ¾ W. 41, S. S. E. ¾ E. 49, E. N. E. ¾ E. 19, W. 21, N. E. ½ E. 36, S. 41, S. S. W. 92, and N. 36 miles; and it be required the latitude and longitude she is in, with the direct course and distance to her intended port.

With the several courses and distances, find their differences of latitude and departure, and set them down as in the following

TRAVERSE TABLE.

COURSES.	DIST.	DIFF. OF LAT.		DEPARTURE.	
		N.	S.	E.	W.
S. by W.	24		23.5		4.7
W. S. W.	32		12.2		29.6
N. W. ¾ W.	41	26.0			31.7
S. S. E. ¾ E.	49		44.3	21.0	
E. N. E. ¾ E	19	4.6		18.4	21.0
West	21				
N. E. ½ E.	36	22.8		27.8	
South	41		41.0		35.2
S. S. W.	92		85.0		
North	36	36.0			
		89.4	206.0	67.2	122.2
			89.4		67.2
		Dif. lat. S.	116.6	Depar.	55.0

n by the Traverse Table, that the ship has made 11
outhing, and 55 miles of westing.

latitude left	50° 4′	Meridion. parts	3
of lat. 117 =	1 57		
n	48 7 N.	Meridion. parts	3
des	2)98 11		
itude	49 5	Mer. diff. lat.	

ce, to find the Difference of Longitude it will be,

Mid. Lat. Sailing.		By Mercator's Sailing.	
nid. lat. 49° 5′	0.18378	As p. diff. of lat. 116.6	7.93
p. 55	1.74036	Is to the dep. 55	1.74
0°	10.00000	So is m. diff. of lat. 179	2.25
ong. 84 = 1° 24′	1.92414	To diff. long. 84.4 = 1° 24′	1.92
5° 42′		Long. left 5 42	
7 6 by m. lat.		Long. in 7 6 by Mer.—	

BY INSPECTION.

the comp. of mid. lat. 41° as a cou. and the dep. 55
nearest is 55.1, against which stands 84 in the dist. c

By Mercator's Sailing.

As mer. diff. of lat. 912	7.04001	As rad. 90°	0.00000
Is to rad. tan. 45°	10.00000	Is to p. diff. lat. 699	2.82543
So diff. of long. 1086	3.03583	So is sec. cou. 49° 59′	0.19178
To tang. cou. 49° 59′	10.07584	To the dist. 1041	3.01721

Hence the direct course from the ship to St. Mary's is S. 50° 7 W. and distance 1043 miles, by Middle Latitude Sailing; and S. 49° 59′ W. and distance 1041 miles by Mercator's Sailing. The same may be found

BY INSPECTION.

Take $\frac{1}{4}$ of the diff. of long. 1086, *viz.* 271.5 nearly, and look for that in the dist. column over the comp. middle lat. 47° nearly, and in the dep. column stands 198.5, $\frac{1}{4}$ of the dep. Then look for $\frac{1}{4}$ of the diff. of lat. 167.2, and $\frac{1}{4}$ of dep. 198.5, until they are found standing together in their respective columns: the nearest are found over 50°, viz. 199.2, 167.5; the dist. corresponding to these is 260, this multiplied by 4 gives 1040 miles. Hence the course is S. 50° W. dist. 1040 miles, by Mid. Lat. Sailing

Again, taking $\frac{1}{10}$ of the meridional diff. of lat. and $\frac{1}{10}$ of the diff. of longitude, viz. 91.2, and 108.6, the nearest numbers to these are 108.8, 91.3 standing over 50° in the lat. column, belonging to the above degree; look for $\frac{1}{10}$ of the proper diff. of lat. viz. 66.9, the nearest is 66.8, the distance is 104, which being multiplied by 10, gives 1040 miles.

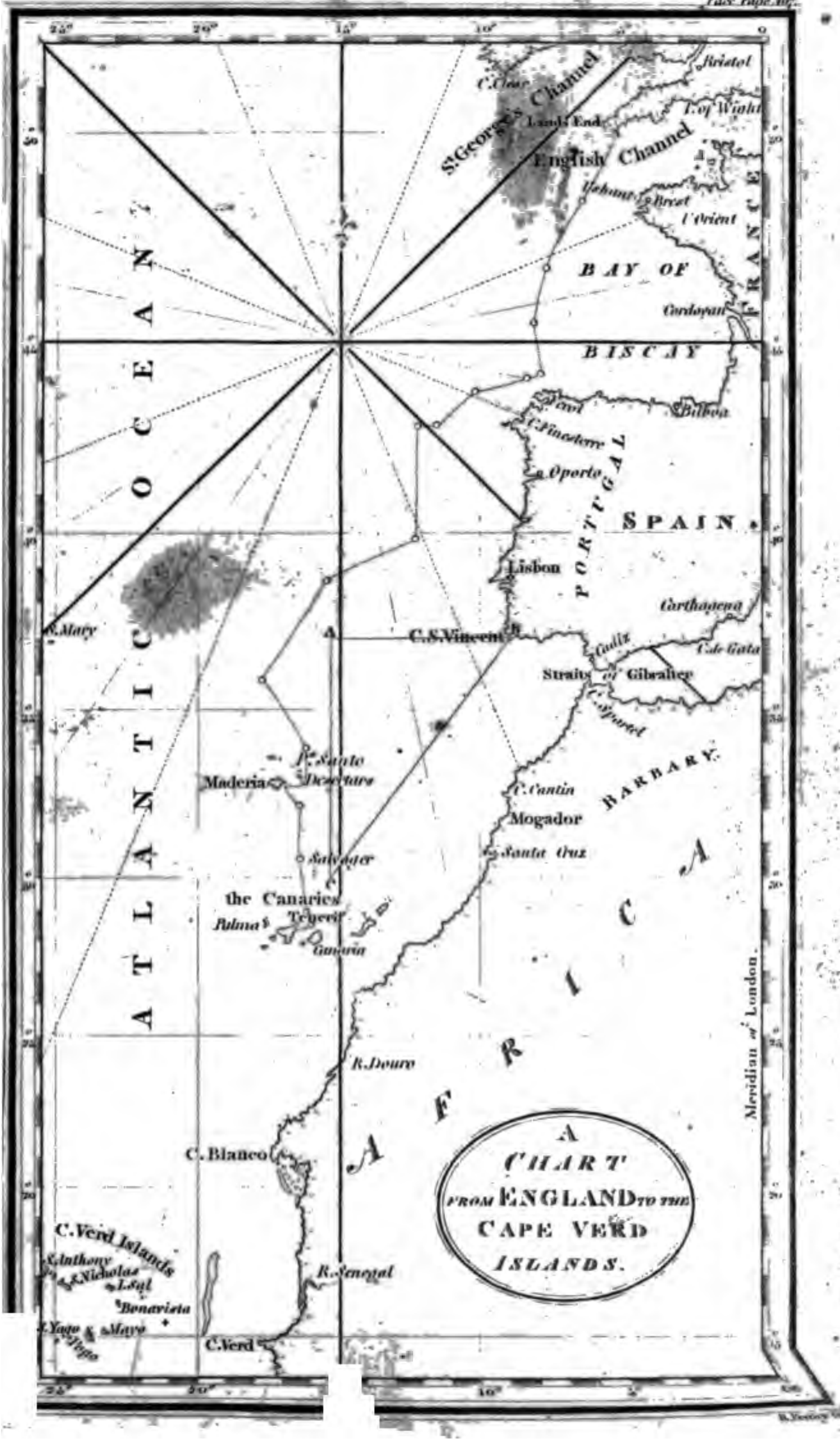
Hence the cou. is S. 50° W. and dist. 1040 miles, by Mercator's Sailing, the same as by calculation.

Here, to have gone to geometrical strictness, the diff. of long. should have been found by every cou. and dist. run, by Mid. Lat. or Mercator's Sailing, which would have given the ship's true place at the end of each cou. and dist. but I shall leave the doing of that to the reader; and as all traverses are worked in the manner shown above, which is sufficiently exact for a ship's run in 24 hours, I shall therefore only add a few questions for the learner's exercise.

Suppose a ship from the lat. 68° 38′ N. and long. 8° 40′ E. is bound to the North Cape, in 71° 10′ N. and long. 26° 1′ E. sails as in the following Table; required the lat. and long. she is in, and her direct cou. and dist. to the Cape.

...ses.	D.	N.	S.	E.	W.	Lat. in		Diff. Long. E.	Diff. Long. W
						68	38		
...y N.	6.	52.4		35·0		69	30	97.	
...E.	38	26.9		26·9		69	57	78.0	
... E.	56	51.7		21.4		70	49	64.2	
...th.	30	30.0				71	19		
...by N.	25	20.8			13.9	71	40	—	44.
... ½ W.	36	31.7			17.0	72	12		55 0
... E.	40	39.2		7.8		72	51	25.9	
... E. ½ E.	72	33.9		63.5		73	25	219.1	
...E.	56		35.4	35.4		72	50	121 0	
... E.	65	24.9		60.1		73	15	207.7	
		311.5	35.4	250.1	30.9			812.9	99.
		35.4		30.9				99.	
...f lat.		276.1	Dep.	219.2		Diff. lon.		713.9	E.

...ing the above, the diff. of long. is found by the co...
...diff. of lat. between each par. of lat.; or it may be do...
the comps. of each mid. lat. and the dep. for each cour...
...at. left was 68° 38′ N. Long. left 8° 40...
...l. 276 ms. = 4 36 N. Diff. long. 714 m = 11 54...


A CHART FROM ENGLAND TO THE CAPE VERD ISLANDS.
ATLANTIC OCEAN
AFRICA
St. George's Channel
English Channel
C. Clear
Land's End
Bristol
I. of Wight
Ushant
Brest
L'Orient
FRANCE
BAY OF BISCAY
Cordovan
Bilboa
C. Finisterre
Oporto
PORTUGAL
SPAIN
Lisbon
Carthagena
C. de Gata
C. S. Vincent
Cadiz
Straits of Gibraltar
C. Spartel
BARBARY
C. Cantin
Mogador
Santa Cruz
P. Santo
Maderia
Desertars
Salvages
the Canaries
Teneriffe
Palma
Canaria
R. Douro
C. Blanco
C. Verd Islands
St. Anthony
St. Nicholas
I. Sal
Bonavista
St. Yago
I. Mayo
C. Verd
R. Senegal
S. Mary
Meridian of London.

found by Mid. Lat. or Mercator, by Inspection, which will be nearly as above.

A ship from the Lizard, in lat. 49° 57′ N. and long. 5° 12′ W. is bound to Funchal in Madeira, in lat. 32° 38′ N. and long. 17° 5′ W. steers the following cou. S. S. W. 250 miles, W. 156, S. E. by S. 300, W. by N. 180, and S. 185 miles; required the lat. and long. she is in, and her direct cou. and dist. to the intended port?

By finding the diff. of long. for each cou. by calculation, the ship is in lat. 39° 27′ N. and long. 11° 25′ W. by Mercator's Sailing; but, by working by the whole diff. of lat. and dep. the long. will be 11° 21′ W.

The cou. from the ship to Funchal is S. 33° 51′ W. dist. 492.4 miles by Mercator's Sailing:

And S. 33° 55′ W. dist. 492.8 miles, by Mid. Lat. Sailing.

A ship from lat. 38° 14′ N. and long 25° 56′ W. runs the following courses and distances, viz. N. E. by N. ½ E. 56 miles, N. N. W. 38, N. W. by W. 46, S. S. E. 30, S. by W. 20, and N. E. by N. 60 miles; required the direct cou. and dist. made good, and the lat. and long. she is in.

The cou. is N. 13° 50′ E. dist. 108 miles lat. in 39° 59′ N. long. in 25° 23′ W.

Suppose a ship in lat. 67° 30′ N. and long. 8° 46′ W. sails the following courses, N. E. 64 miles, N. N. E. 50, N. W. by N. 58, W. N. W. 72, W. 48, S. S. W. 38, S. by E. 45, and E. S. E. 40 miles; what lat. and long. is she in?

By working by the whole diff. of lat. and. dep. the ship is in lat. 68° 43′ N. and long. 11° 3′ W. But

By finding the diff. of long. for each cou. and dist. she is in long. 11° 38′ W. by Mid. Lat. Sailing, and 11° 43′ W. by Mercator's Sailing.

Having gone through the necessary Problems in Mercator's Sailing, we shall now proceed to show how the true chart, commonly called Mercator's Chart, may be constructed either for the whole or any part of the Terraqueous Globe.

When a Chart is to commence from the Equator, or if the Equator is to run through it.

Having provided a scale of convenient length, draw a line to represent the Equator, and, crossing that at right angles, another to represent the meridian of some known place, such as Greenwich, Paris, the Lizard, or any other place whose longitude is known; the upper end of which will represent the north, and the lower the south.

From the scale take 60 in your compasses, and with 1 foot upon the meridian, set off that distance on both sides of it upon the equator, if the chart is to contain east and west longitude; but if it is only to contain west longitude, lay it off upon the left-hand side of the meridian; but if easterly, on the right-hand side, and that

will point out the degrees of longitude, which may be divided into halves, quarters, or minutes, if required.

Having set off as many degrees of longitude as you intend the chart should contain, through the last draw a line (or lines) parallel to the meridian, which will be the bounds of the chart east and west.

Having divided the equator as above, proceed to set off upon the two extreme meridians from the equator, the meridional parts (as found in the table) belonging to each degree of latitude; that is, take from the scale in your compasses the miles answering to one degree in the table, and, with one foot in the equator, set off that distance upon each side of it upon the extreme meridians, if the chart is to contain north and south latitude; but if only north or south, upon one side of the equator.

Again, take the meridional parts answering to 2 degrees and 3 degrees, &c. in your compasses, and set them off upon the meridian, from the equator, as before.

In like manner proceed to set off as many degrees as you intend the chart should contain; or, which will be the same thing, take the meridional difference of latitude between any two parallels, and set them off severally from the least latitude.

Lay a ruler on each of these divisions, and draw lines parallel to the equator, and they will be parallels of latitude, each of which will be enlarged towards the poles, in proportion as the degrees of longitude are.

Parallel to the meridian, draw lines through the points, expressing the degrees of longitude, to cut the parallels of latitude, which bound the chart north and south.

The parallels of latitude may also be divided into halves, quarters, or minutes, by taking the meridional parts for degrees and minutes, and setting them off as before.

Draw double lines on the borders of the chart, and mark out the degrees of latitude and longitude; and, in some convenient place, draw the compass. In like manner may a chart be made that shall contain any number of degrees and minutes required. When the chart is not to commence from the equator, but is only to serve from a certain distance on the meridian, between two parallels on the same side of the equator, then the meridians are to be drawn as before, and for the parallels of latitude you are to proceed thus:—

From the meridional parts answering to each point of latitude in your chart, subtract the meridional parts answering to the least latitude, and set off the difference severally from the parallels of the least latitude upon the two extreme meridians, and the lines joining these points of the meridian will represent the several parallels upon the chart.

Let it be required to draw a chart that shall serve from the latitude of 14 degrees north, to 52 degrees north, and that shall contain 25 degrees of longitude west of the meridian of Greenwich. *See the Chart, page 107.*

Draw a line to represent the meridian of Greenwich, from which set off towards the left hand 25 degrees of west longitude, as before directed; through the two last points draw lines parallel to the meridian of London, and these will be the extreme meridians, or east and west bounds of your chart.

Having drawn the two meridians on the lower edge of the paper, draw a line perpendicular to the meridians, to represent the parallel of 14 degrees north; then, from the meridional parts answering to 15 degrees 910, subtract the meridional parts answering to 14 degrees 849, and take the difference, 61, in your compasses, and set it off from the parallel on both the meridians from you, and that will represent the parallel of 15 degrees.

Again, take the meridional parts of 15 degrees 910, from the meridional parts of 16 degrees 973, and set off the difference 63, upon the meridians from the point representing the parallel of 15 degrees, and that will represent the parallel of 16 degrees. In like manner proceed to set off the parallels upon the meridians.

Or, if the meridional parts of 14 degrees be subtracted from the meridional parts of every succeeding parallel, and the difference be set off from the parallel of 14 degrees upon the meridians, these points will represent the several enlarged parallels of latitude, the same as before; and, if it be required that the meridians should be divided into degrees and minutes, the meridional parts for such must be taken from the Table, and set off as above.

Having set off as many parallels as you intend the chart should contain, through each point draw parallels; or if you think drawing lines through every degree will crowd your chart too much, you may divide the borders only into single degrees, &c. and draw lines through every 5 degrees of latitude and longitude, as in the chart.

Take from the Table of Latitude and Longitude of Places, the latitude and longitude of each particular place contained within the bounds of the chart, and lay a ruler over its latitude, and another crossing that over its longitude; the points where these cross will represent the proposed place upon the chart. In like manner may any place be readily marked. Hence the particular points of a sea-coast may be laid down as above, and lines properly drawn from point to point will form the outline of the sea-coasts, islands, &c. to which may be annexed, the depths of water, setting of currents, and whatever else may be thought convenient for the chart to contain.

This map or chart is not to be considered as a just or similar representation of the earth's surface, for in it the figures of islands and countries are distorted near the poles. For

Suppose an island in the latitude 60° N. or S. where the breadth of a degree of longitude is just half as large as a degree upon the equator. Now, as the degrees of latitude are enlarged in proportion as the degrees of longitude are expanded towards the poles, it is plain, *that every point of that* island or country, being laid down

SES.	D	N.	S.	E.	W.	LAT. IN		Diff. Long. E.	W
						68	38		
by N.	6	52.4		35.0		69	30	97.	
E.	38	26.9		26.9		69	57	78.0	
. E.	56	51.7		21.4		70	49	64.2	
rth.	30	30.0				71	19		
by N.	25	20.8			13.9	71	40		44.
V. ½ W.	36	31.7			17.0	72	12		55 0
y E.	40	39.2		7.8		72	51	25.9	
E. ½ E.	72	33.9		63.5		73	25	219.1	
E.	50		35.4	35.4		72	50	121 0	
. E.	65	24.9		60.1		73	15	207.7	
		311.5	35.4	250.1	30.9			812.9	99.
		35.4		30.9				99.	
of lat.		276.1	Dep.	219.2		Diff. lon.		713.9	E.

ing the above, the diff. of long. is found by the co
diff. of lat. between each par. of lat.; or it may be do
the comps. of each mid. lat. and the dep. for each cours
lat. left was 68° 38 N. Long. left 8°40
l. 276 ms. = 4 36 N. Diff. long. 714 m = 11 54

place lies to the right hand of the north and south line, or to the left hand if it lies to the west; and make a mark with a black-lead pencil; this mark will serve to prick off by, till you come to take a new departure; and then rub it out, and make a new one as before.

Then lay a ruler across the chart in the latitude you are in; and taking so many degrees in your compasses from the line of longitude, as your longitude made comes to, set them off from your black-lead mark along the edge of the ruler to the eastward, if the longitude made be east, or to the westward if it be west; where this falls, will be the longitude the ship is in by the chart; from which take the nearest distance to some north and south line, and from where that line, &c. as in the first case.

The ship's place on the chart being found, as before taught, it remains in the next to show how to find the bearing and distance of any place from the ship; and first,

To find how any Place bears from the Ship.

Rule. Lay a ruler from the place of the ship to the place you would know the bearing of; then set one foot of your compasses in the centre of some compass near the ruler, and take the nearest distance to the edge of the ruler: then run one foot of your compasses along by the edge of the ruler, and observe what point of the compass the other comes nearest to, which will be the bearing required.

CASE I.

To find the Distance of any Place from the Ship.

If the place be in the same longitude that the ship is in, that is, if it bears due north or south, then the difference of latitude between them, turned into miles or leagues, will be the distance.

CASE II.

If the place be in the same latitude the ship is in, that is, if it bears due east or due west, then take half the distance between the ship and the place in your compasses; and, setting one foot on the line marked with the degrees of latitude, in the latitude the ship is in, see what latitudes the other foot will reach to, both above and below it; the difference between these two latitudes will be the distance required.

CASE III.

When they are neither in the same Latitude nor in the same Longitude with the Ship.

Rule. Take the difference of latitude between both places in your compasses from the equator, or graduated parallel; and laying a ruler over both places, put one foot upon the ship's place, and

slide your compasses along the edge of the ruler (holding both points parallel to the meridian) until the other cuts the parallel of latitude passing through the place (or any E. and W. line cut by the ruler), then stay the compasses. Take the distance between where the point rested by the edge of the ruler, and the place (or where the ruler crossed the aforesaid east and west line), in your compasses, and apply it to the equator, or graduated parallel, and that will give their distance in degrees, which may be turned into miles or leagues; and in the same manner as you find the bearing and distance between the ship and any place, you may also find the bearing and distance of one place from another; or if the distance between the ship and place be taken in your compasses, and applied to the side of the chart, or graduated meridian, nearly in the parallels of the ship and place, it will give the distance in degrees as before; and for this purpose there are generally marked on the sides of charts scales of leagues, by which the distance between the places may be readily found.

Or the distance between two places upon a Mercator's Chart may be easily found, thus:

Take half the distance between any two places, and with one foot of the compasses in the middle parallel, extend both ways upon the graduated meridian; count the number of degrees between both points, which will be your distance, either in leagues or miles, according as the scale is divided; or take the distance in your compasses, and set one foot as much above the one place as the other point is below the other place, on the meridian: the number of degrees between the points of the compassess will be the distance.

EXAMPLE.

Required the Bearing and Distance between Cape St. Vincent *and* Teneriffe.

Lay a ruler over both places, and take their difference of latitude $8^{\circ}\ 30'$, from the equator or graduated parallel, in your compasses; and slide one foot along the edge of the ruler from Teneriffe, holding the other point in the direction of the line CB, until the other point just touches the east and west line, (AB) passing through St. Vincent, as at B, from C, where the foot of the compasses rested, by the edge of the ruler, and St. Vincent being measured, and applied to the graduated parallel, gives 10 two-third degrees, or 640 miles the distance.

Again, take the nearest distance between the centre of the compass in your compasses, and sliding them along the edge of the ruler, as before directed, you will find the course to be S. W. by S. ¼ W. nearly.

Hence the direct course between Cape St. Vincent and Teneriffe is S. W. by S. ¼ W. distance 640 miles, or 213 one-third leagues; and the same with other places.

OF WINDS.

THE earth is endued with a wonderful principle of gravitation, whereby all its parts are strictly united together; and all bodies that are loose upon it closely adhere to its surface, tending directly towards its centre. Hence it is, that ships are able to sail with the same facility every where (void of impediments) upon the surface of the sea, quite round the terraqueous globe; and that (as to sense) there is no such thing as an upper or lower part of the earth; for let the inhabitant be in what part soever, he will there gravitate towards the earth's centre, and imagine himself to be on the highest point of its surface; from whence he will observe the heavens like a large vault over his head, and his antipodes he will imagine to be directly under him, as they will also theirs for the like reasons. According to this law of gravity, if the earth was at rest (and not acted upon by any other power), and its parts loose, or its surface all over covered with a deep fluid, it would naturally form itself into a true sphere, or globe.

Notwithstanding this power of attraction, yet the sun, whose rays upon the earth cause vapours or fumes to be continually rising from it, which must partake of the quality of those parts from whence they are evaporated; a collection of which form what we call our air or atmosphere, surrounding the earth, and extending some miles above its surface, and is liable to be put in motion by various causes. Hence, air is a fine elastic fluid, and is found capable of being compressed or condensed by cold, and expanded or rarefied by heat.

Consequently, an alteration of heat or cold happening in any part of the atmosphere, the air in that part will be either condensed or rarefied, and the neighbouring parts will thereby be put into motion, through the endeavour which the air by its elasticity or springiness always makes to restore itself to its former state, or come to an equilibrium.

Wind is a stream or current of air, which generally blows from one part of the horizon to its opposite.

The following observations have been made on it, particularly by Dr. Halley, which are not unworthy the Seaman's notice.

Between 30 degrees north latitude, and 30 south latitude, there is a constant east wind throughout the year, blowing on the Atlantic and Pacific oceans, and this is called the Trade-Winds.

For as the sun, in moving from east to west, heats the air more immediately under him, and thereby expands it; the air to the eastward is constantly rushing towards the west to restore the equilibrium or natural state of the atmosphere, which occasions a perpetual *east wind in those limits.*

The trade-winds, near these northern limits, blow between the north and east; and, near the southern limits, they blow between the south and east.

For as the air is expanded by the heat of the sun near the equator, therefore the air from the northward and southward will both tend toward the equator to restore the equilibrium: now these motions from the north and south, joined with the foregoing easterly motions, will produce the motions observed near those limits, between the north and east, and between the south and west.

These winds, if the whole surface of the globe were sea, would undoubtedly blow quite round it, as they are found to do in the Atlantic and Ethiopic oceans; but seeing such great continents interpose and break the continuity of the ocean, regard must be had to the nature of soils, and the positions of high mountains, which are the principal causes of the variety of winds differing from the former general one.

In some parts of the Indian ocean there are periodical winds, which are called Monsoons: that is, such as blow half the year one way, and the other half the contrary way.

For air that is cool and dense will force the warm and rarefied air into a continual stream upwards, where it must spread itself to preserve the equilibrium: so that the upper course or current of the air shall be contrary to the under current; for the upper air must move from those parts where the greatest heat is, and so by a kind of circulation the N. E. trade-wind below will be attended with a S. W. above; and a S. E. below, with a N. W. above:—And this is confirmed by the experience of seamen, who, as soon as they get out of the trade-winds, immediately find a wind blowing from the opposite quarter.

In the Atlantic ocean, near the coasts of Africa, at about 100 leagues from shore, between the latitudes of 28° and 10° north, seamen constantly meet with a fresh gale of wind blowing from the N. E.

Those bound to the Caribbee Islands, across the Atlantic, find, as they approach the American side, that the N. E. wind becomes easterly, or seldom blows more than a point from the east, either to the northward or southward.

The trade-winds on the American side are extended to 30°, 31°, or even to 32° of north lat.; which is about 4° farther than what they extend to on the African side; also, to the southward of the equator, the trade-winds extend 3 or 4 degrees farther towards the coast of Brasil on the American side, than they do near the Cape of Good Hope on the African side.

Between the latitudes of four degrees north, and four south, the wind always blows between the south and east: on the African side the winds are nearest the south, and on the American side nearest the east. In these seas Dr. Halley observed, that when the wind was eastward, the weather was gloomy, dark, and rainy, with hard gales of wind; but when the wind veered to the south-

ward, the weather generally became serene, with gentle breezes, next to a calm.

These winds are somewhat changed by the season of the year; for when the sun is far northward, the Brasil S. E. wind gets to the south, and the N. E. wind to the east; and when the sun is far south, the S. E. wind gets to the east, and the N. E. wind on this side of the equator veers more to the north.

Along the coast of Guinea, from Sierra Leone to the island of St. Thomas, under the equator, which is above 500 leagues, the southerly and S. W. winds blow perpetually; for the S. E. trade-wind having passed the equator, and approaching the Guinea coast, within 80 or 100 leagues, inclines towards the shore, and becomes S. S. E., then south, and by degrees, as it comes near the land, it veers about to S. S. W, and within the land it is S. W. and sometimes W. S. W. This tract is troubled with frequent calms, and violent sudden gusts of wind, called Tornadoes, blowing from all points of the horizon.

The reason of the wind setting in west on the coast of Guinea is, in all probability, owing to the nature of the coast, which, being greatly heated by the sun, rarefies the air exceedingly, and consequently the cool air, from off the sea, will keep rushing in to restore the equilibrium.

Between the 4th and 10th degrees of north latitude, and between the longitude of Cape Verd, and the eastmost of the Cape Verd islands, there is a tract of sea which seems to be condemned to perpetual calms, attended with terrible thunder and lightning, and such frequent rains, that this part of the sea is called The Rains. Ships in sailing these 6 degrees have been sometimes detained whole months, as is reported.

The cause of this seems to be, that the westerly winds setting in on this coast, and meeting the general easterly winds in this tract, balance each other, and so cause the calms; and the vapours carried thither by each wind meeting and condensing, occasion the almost constant rains.

The last three observations show the reason of the two following, which mariners experience in sailing from Europe to India, and in the Guinea trade. The difficulty which ships in going to the southward, especially in the months of July and August, find in passing between the coast of Guinea and Brazil, notwithstanding the width of the sea is not more than 500 leagues. This happens because the S. E. winds at that time of the year commonly extend some degrees beyond the ordinary limits of 4° N. latitude; and besides, coming so much southerly, as to be sometimes south, sometimes a point or two to the west; it then only remains to ply to windward. And if, on the one side, they steer W. S. W. they get a wind more and more easterly; but then there is danger of falling in with the Brazilian coast, or shoals; and if they steer E. S. E. they fall into the neighbourhood of the coast of Guinea, from whence they cannot depart without running easterly as far as

the island of St. Thomas; and this is the constant practice of all the Guinea ships.

All ships departing from Guinea for Europe, their direct course is northward; but on this course they cannot go, because the coast being nearly east and west, the land is to the northward; therefore as the winds on this coast are generally between the S. and W. S. W. they are obliged to steer S. S. E. or S. and with these courses they run off the shore; but in so doing they always find the wind more and more contrary, so that when near the shore they can lie south; at a great distance they can make no better than S. E. and afterwards E. S. E. with which courses they generally fetch the island of St. Thomas, and Cape Lopez, where finding the winds to the eastward of the south, they sail westerly with it, till coming to the latitude of four degrees south, where they find the S. E. wind blowing perpetually.

On account of these general winds, all those that use the West-India trade, even those bound to Virginia, reckon it their best course to get as soon as they can to the southward, that so they may be certain of a fair and fresh gale to run before it to the westward; and for the same reason those homeward bound from America endeavour to gain the latitude of 30°, where they first find the wind begin to be variable, though the most ordinary winds in the North Atlantic ocean come between the south and west.

Between the southern lats. of 10° and 30° in the Indian ocean, the general trade-wind, about S. E. by S. is found to blow all the year round in the same manner as in the like lats. in the Ethiopic ocean: and during the six months, from May to December, these winds reach to within 2° of the equator; but during the other six months, from November to June, a N. W. wind blows in the tract lying between the 3d and 10th degrees of southern lat. in the meridian of the north end of Madagascar; and between the 2d and 12th degrees of south lat. near the long. of Sumatra and Java.

In the tract between Sumatra and the African coast, and from 3° of S. lat. quite northward to the Asiatic coast, including the Arabian sea and the Gulf of Bengal, the monsoons blow from September to April on the N. E. and from March to October on the S. W. In the former half-year, the wind is more steady and gentle, and the weather clearer, than in the latter six months: and the wind is more strong and steady in the Arabian sea than in the Gulf of Bengal.

Between the island of Madagascar and the coast of Africa, and hence northward as far as the equator, there is a tract wherein, from April to October, there is a constant fresh S. S. W. wind, which, to the northward, changes into the W. S. W. wind blowing, at that time, in the Arabian sea.

To the eastward of Sumatra and Malacca, on the north of the equator, and along the coasts of Cambodia and China, quite through the Philippines, as far as Japan, the monsoons blow northerly and southerly; the northern setting in about October or No-

vember, and the southern about May. These winds are not quite so certain as those in the Arabian sea.

Between Sumatra and Java to the west, and New Guinea to the east, the same northerly and southerly winds are observed: but the first half-year the monsoons incline to the N. W. and the latter to the S. E. These winds begin a month or six weeks after those in the Chinese seas set in, and are quite as variable.

These contrary winds do not shift from one point to its opposite all at once; in some places the time of the change is attended with calms; in others by variable winds; and it often happens on the shores of Coromandel and China, towards the end of the monsoon, that there are most violent storms, greatly resembling the hurricanes in the West Indies, wherein the wind is so vastly strong, that hardly any thing can resist its force.

All navigation in the Indian ocean must necessarily be regulated by those winds: for if mariners should delay their voyages till the contrary monsoon begins, they must either sail back, or go into harbour, and wait for the changing of the trade-winds.

Vapours rising from the sea, and by the wind carried over low lands to the ridges of mountains, and compelled to mount up with the stream of the air to the tops, where the water presently precipitates, gliding down by the chinks and cliffs of the stones, and part of the water entering into the caverns of hills, and gathering into basons, which being once filled begin to run over, and form subterraneous passages through the earth, breaking out in springs by the sides of hills; several of those meeting together form a rivulet; several of these rivulets meeting together make a river. This, together with what is incorporated into vegetables, renders it impossible for all the water evaporated from the sea to return to it again.

Hence the evaporations arising from the Mediterranean are such, that notwithstanding there are nine capital rivers, which empty themselves into it, beside smaller ones, there is a constant current running through the Straits of Gibraltar from the Atlantic ocean to make up the deficiency. R. Mean, M. D. and F. R. S. observes, 1. That some diseases are probably the effects of the influence of the heavenly bodies. 2. That the most windy seasons of the year are about the vernal and autumnal equinoxes. 3. All the changes we have enumerated in the atmosphere do fall out at the same times when those happen in the ocean; and, as both the waters of the sea and the air of our earth or fluids are subject in a great measure to the same laws of motion, so that natural effects of the same kind are owing to the same causes. 4. The alteration made by the sun and moon in the atmosphere must thereby have influence on the animal body. 5. The elasticity of the air is of great moment, and it is reciprocally as the pressure, so that the incumbent weight being diminished by the attraction, the air underneath will be much expanded; these, and such-like causes, will make the tides in the air to be much greater than those of the ocean; and there is no doubt to be made, but that the same infinitely wise Being, who contrived

the flux and reflux of the seas, to secure that vast collection of waters from stagnation and corruption, has ordered this ebb and flood of the air of our atmosphere with the like good design; that is, to preserve it sweet, and a brisk temper of this fluid so necessary to life, by a continual circulation. 6. Two contrary winds blowing towards the same place, may accumulate the air there, so as to increase the height and the weight of the incumbent cylinder; in like manner the direction of two winds may be such, as meeting at certain angles, may keep the gravity of the air in a middle state; but if the wind blows different ways from the same place (which may be occasioned by thunder and lightning) the height and weight of the air may be much decreased. 7. The changes in our atmosphere at high-water, new and full moon, the equinoxes, &c. must occasion alterations in all animal bodies, for all living creatures require air of a determined gravity to perform respiration easily; for it is by its weight that this fluid insinuates itself into the cavity of the breast and lungs: by a slow circulation the secretion of the spirits is diminished; and by the want of the force of elasticity and gravity, the juices begin to ferment, change the union of their parts, break their canals, and diseases follow.

Besides the above causes, the atmosphere may be put in motion by the elastic vapours forced from the bowels of the earth by subterraneous heats, and condensed by whatever causes in the atmosphere. A mixture of effluvia in different qualities in the air may, by rarefaction, fermentation, &c. produce winds and other effects like those resulting from the combination of some chemical liquors; and that such things happen, we are assured from the nature of thunder, lightning, and meteors. From the eruption of volcanoes and earthquakes in distant places, wind may be propagated to remoter countries. The divided or united forces of the other planets, and of the comets, may variously disturb the influence of the sun, the moon, &c. We know that there happen violent tempests in the upper region of the air, when we below enjoy a calm; and how many ridges of mountains there are on our globe which interrupt and check the propagation of the winds, so that it is no wonder that the phenomena we have ascribed to the action of the sun and moon, are not always constant and uniform, and that every effect does not hereupon follow; which were there no other powers in nature able to alter the influence of, this might, in a very regular and uniform manner, be expected from it.

That the rarefied air ascends is sufficiently demonstrated by the aerostatic globe, or air-balloon, lately invented: this is a globe made of silk, or other light stuff, made air-tight with gum; which, being filled with inflammable or rarefied air, will, when let loose, ascend, until it comes to that part of the atmosphere that is nearly as light as the air within it, where it will continue some time.

OF TIDES.

A TIDE is that motion of the water in the seas and rivers, by which they regularly rise and fall: the general cause of which was discovered by Sir ISAAC NEWTON, and is deduced from the following considerations:——Daily experience shows, that all bodies, when thrown upwards from the earth, fall down to its surface in perpendicular lines; and as lines perpendicular to the surface of any sphere tend towards its centre, the lines, along which all heavy bodies fall, must be directed towards the earth's centre.

As bodies appear to fall by their weight or gravity, the law, by which they descend, is called the law of gravitation: and as a magnet or loadstone will draw small portions of iron or steel, and as a piece of glass, amber, or sealing-wax, when warmed by rubbing, will draw small bits of paper, and other light substances, the law, by which such bodies fly to those which draw them, is called the law of attraction. Hence it is not improper to say, that bodies, when falling by their gravity towards the earth, are *attracted* by the earth; and therefore the words gravitation and attraction may, respecting the earth, be used indifferently, as by them is only meant that power, or law, by which all bodies tend towards its centre.

Sir ISAAC discovered, by a great number of observations, that this law of gravitation or attraction was universally diffused throughout the solar system; and that the regular motions, observed among the heavenly bodies, were governed by it; so that the earth and moon attract each other, and both of them are attracted by the sun. He also discovered, that the force of attraction, mutually exerted by these bodies, was lessened as the distance increased, in proportion to the squares of those distances; that is, the power of attraction, at double the distance, was four times less; at triple the distance, nine times less; at quadruple the distance, sixteen times less, and so on.

As the earth is attracted by the sun and moon, it follows, that all the parts of the earth will not gravitate towards its centre in the same manner as they would do, if those parts were not affected by such attractions. And it is evident, that were the earth entirely free from such actions of the sun and moon, the ocean, being on all sides equally inclined towards its centre by the force of gravity, would continue in a perfect stagnant state, without ever ebbing or flowing. But, as the case is otherwise, the water in the ocean must needs rise higher in those places where the sun and moon diminish its gravity, or where they have the greatest attraction.

As the force of gravity must be diminished most in those parts of the earth to which the moon is nearest, or in the zenith, because her attraction will there be most powerful; therefore the waters, in such places, will rise higher, and it will in them be full sea or high-water. The parts of the earth directly under the moon, and also those in the nadir, viz. such places as are diametrically opposite to those where the moon is in the zenith, will have high-water at the same time. For either half of the earth would gravitate equally towards the other half, were they superfluous free from all attraction. But by the action of the moon, the gravitation of one half of the earth towards its centre is diminished, and that of the other increased. In the half-earth next the moon, the parts directly under her being most attracted, and consequently their gravitation towards the earth's centre most diminished, the waters in these parts must be higher than in any other part of this half-earth. And in the half-earth farthest from the moon, the parts in the nadir being less attracted by her than those which are nearer, gravitate towards the earth's centre, and consequently, the waters in those parts must be higher than they are in any other part of this half-earth.

Those parts of the earth where the moon appears in the horizon, or is 90 degrees distant from the zenith and nadir, will have their lowest waters. For as the waters in the zenith and nadir rise at the same time, the adjacent waters will press towards those places to restore the equilibrium; and to supply the places of these, others will move the same way, and so on to 90° distant from the said zenith and nadir: consequently the waters, in those places where the moon appears in the horizon, will have most liberty to descend towards the centre; and therefore they will, in such places, be the lowest. Hence it plainly follows, that the ocean, if it covered the surface of the earth, would put on a spheroidal, or egg-like figure, in which the longest diameter would pass through the place where the moon is vertical; and the shortest where she is in the horizon. And as the moon apparently shifts her position from east to west in going round the earth every day, the long diameter of the spheroid, following that motion, would occasion the two floods and ebbs in about every 25 hours, which is about the length of a lunar day, or the time spent between the moon's leaving the meridian of any place, and her coming to it again. Hence the greater the moon's meridian altitude is at any place, the greater will those tides be which happen when she is above the horizon; and the greater her meridian depression is, the greater will those tides be, which happen when she is below the horizon. The summer day, and the winter night, tides, have a tendency to be the highest; because the sun's summer elevation, and his winter depression, are greatest: this is more especially to be observed when the moon has north declination in summer and south declination in winter.

The time of high-water is not precisely at the time of the moon's

coming to the meridian, but about an hour after. For the moon continues to act with some force after she has passed the meridian, and by that means adds to the libratory, or waving motion, which she put the water into whilst she was on the meridian; in the same manner as a small force applied upwards to a ball, already raised to some height, will raise it still higher. The tides are greater than ordinary twice every month; that is, about the times of new and full moon: they are called spring-tides. At these times the sun and moon concur to draw in the same right line; and therefore the sea must, under such joint influences, be more elevated than at other times. During the time of their conjunction, or whilst they are on the same side of the earth, they both conspire to raise the water in the zenith, and consequently in the nadir: and when the sun and moon are in opposition, that is, when the earth is between them, whilst one makes high-water in the zenith and nadir, the other does the same in the nadir and zenith. The tides are less than ordinary twice every month; that is, about the times of the first and last quarters of the moon; these are called neap-tides: because in the quarters of the moon, the sun raises the water where the moon depresses it, and depresses where the moon raises the water; so that the tides are then caused only by the difference of their actions. Hence it is necessary to observe, that the spring-tides happen not exactly at the new and full moon, but generally three days after, when the attracting powers of the sun and moon have conspired for a considerable time. In like manner the neap-tides happen about three days after the quarters, when the moon's attraction has been lessened by that of the sun for several days together.

When the moon is in her *perigeum*, or nearest approach to the earth, the tides rise higher than they do under the same circumstance at other times; for, according to the laws of gravitation, the moon must attract most when she is nearest the earth. The spring-tides are greater about the time of the equinoxes, that is, about the latter end of March and September, than at other times of the year; and the neap-tides are then less; because the longer diameter of the spheroid, or the two opposite floods, being then in the earth's equator, will describe a great circle of the earth; by the diurnal rotation of which, those floods will move swifter, describing a great circle in the same time they used to describe a less one parallel to the equator; and consequently the waters being thrown more forcibly against the shores, must cause them to rise higher.

The following observations have been made on the rise of the tides: namely, the morning tides generally differ in their rise from the evening-tides. The new and full moon spring-tides rise to different heights. In winter the morning tides are highest. In summer the evening tides are highest. Thus it appears, that, after a period of about six months, the order of the highest tides are inverted; that *is, the rise of the* morning and evening tides will

change places, the winter-morning high-tides becoming the same as the summer-evening high-tides. Some of these effects arise from the different distances of the moon from the earth after a period of six months, when she is in the same situation with respect to the sun; for, if she be in perigee at the time of the new moon, she will, in about six months after, be in perigee about the time of full moon. These particulars being well known, a pilot may choose that time which will prove most convenient for conducting a ship out of any port, where there is not a sufficient depth of water on common spring-tides.

Small inland seas, such as the Mediterranean and Baltic, are little subject to tides; because the action of the sun and moon is always nearly equal to the extremities of such seas. The tides, in very high latitudes also, are very inconsiderable; for the sun and moon acting towards the equator, and always raising the water towards the middle of the torrid zone, the neighbourhood of the poles must consequently be deprived of the waters, and the sea within the frigid zones must be low in comparison to the other parts.

All the things hitherto explained would be exactly obtained, were the whole surface of the earth covered with sea. But since there are a multitude of islands, besides continents, lying in the way of the tide, which interrupt its course; therefore there arise, in many places near the shores, a great variety of other appearances, besides the foregoing ones, which require particular solutions, in which the situations of the shores, straits, shoals, winds, and other things, must necessarily be considered. For instance; as the sea has no visible passage between Europe and Africa, let them be supposed one continent, extending from 79° north to 34° south: the middle of those two would be in latitude 19° north, near Cape Blanco, on the west coast of Africa. But it is impossible the flood tide should set to the westward, upon the western coast of Africa (for the general tide, following the course of the moon, must set from east to west), because the continent, for above 60°, both northward and southward, bounds that sea on the east; and therefore, if any regular tide, proceeding from the motion of the sea from east to west, should reach this place, it must be either from the north of Europe southward, or from the south of Africa northward.

This opinion is further corroborated, or rather fully confirmed, by common experience, which shows that the flood-tide sets to the southward along the west coast of Norway from the North Cape to the Naze or entrance of the Baltic Sea, and so proceeds to the southward along the east coast of Great Britain, and in its passage supplies all those ports which lie in its way, one after another. The coast of Scotland has the tide first, because it comes from the northward to the southward. On the full and change days, it is *high-water* at Aberdeen at 12 h. 45 m. but at Tinmouth-bar not *till 3 h.* Rolling thence to the southward, it makes high-water at

the Spurn a little after 5h., at Yarmouth Roads a little after 8h. at Harwich at 11h. 30m., at the Nore 12h., and at London 2h. 30m., all in the same day. And although this may seem to contradict the hypothesis of the natural motion of the tides being from east to west, yet as no tide can come west from the main continent of Norway or Holland, it is evident that the tide we have been tracing, by its several stages from Scotland to London, is supplied by that tide, the original motion of which is from east to west. As water always inclines to the level, it will in its passage fall to any other point of the compass, to fill up vacancies where it finds them; and yet not contradict, but rather confirm, the hypothesis.

While the flood-tide is thus gliding to the southward along the east coast of England, it also sets to the southward along the west coasts of Scotland and Ireland; one branch of it falls back north-east into St. George's Channel; and another runs between Ushant and the Lizard, into the British Channel. Some may object that this course of the flood-tide, east up the Channel, is quite contrary to the hypothesis of the general motions of the tides being from east to west; and consequently of its being high-water where the moon is vertical, or any where else on the meridian. But it may be answered, that this particular direction of the tides does not contradict the general direction of the whole. A river with a western course may supply canals which wind north, south, or even east, and yet the river keep its natural course; and if the river ebbs and flows, the canals supplied by it would also do the same, although they did not keep exact time with the river; because it would be flood, and the water advanced to some height in the river, before it reached the farthest part of the canals; and the more remote the extremity of the canals are, the longer time it would require; it may also be added, that if it were high-water in the river just when the moon was on the meridian, she would be far past it before it could be high-water in the remotest part of those canals; and the flood would set according to the course of the canals that received it, and could not set west upon a canal of a different position. As St. George's Channel, the British Channel, &c. are no more in proportion to the vast ocean, than such canals would be to a large navigable river; it will evidently follow that the flood-tide may, among those obstructions and confinements, set upon any other point of the compass, as well as west; and may make high-water at any other time, as well as when the moon is upon the meridian, without any-wise contradicting the general theory of the tides.

Among pilots it is customary to reckon the times of high-water by the point of the compass the moon bears on at that time, allowing three quarters of an hour for each point. Thus, in places where it is high-water at noon, on the full and change days, the tide is said to flow north and south, or 12 o'clock. In places *where the moon bears 1, 2, 3, 4,* or more points to the eastward of

westward of the meridian, when it is high-water on such days, the tide is said to flow on such a point; so, if the moon bear south-east, at high-water, it is said to flow south-east and north-west, or 9 o'clock; if she bears south-west, it flows south-west and north-east, or 3 o'clock; and in like manner for every other point of the moon's bearing.

From the observations of many persons, the times of high-water on the days of the new and full moon on most of the coasts of Europe, and several other places, have been collected; and those are generally put in a table, against the names of their respective places in an alphabetical order; hence it is called the Tide Table, which is at the end of the book.

The method generally prescribed for finding the time of high-water at any place, is contained in the following particulars:

To find the Leap Year.

Divide the given year by 4, if nothing remains, it is leap-year, but if 1, 2, or 3 remains, they show that it is so many years after Bissextile or Leap-year, as the remainder is: thus, in the year 1810, divided by 4, gives 452, and the remainder [2] shows it is the second year after Bissextile, or Leap-year.

To find the Golden Number for any Year.

RULE. Add one to the given year, and divide the sum by 19, the remainder will be the Golden Number.

EXAMPLE.

Required the Golden Number of 1810?

By adding one to that year, it gives 1811; this divided by 19 gives 95 for the quotient, and the remainder is 6, the Golden Number for 1810.

To find the Epact for any Year.

NOTE. The Epact is the moon's age at the beginning of the year, or rather the 1st of March. The Epact advances 11 every year to 30, because the solar year is 11 days longer than the lunar year, and as the Epact increases, it shows the moon's age at the beginning of the year; it is here supposed that at the end of 19 years, the sun and moon make all the variety of situations they possibly can with one another, and thence begin, and go over the same again. The Golden Number at the birth of Christ was 1, which is the reason that one is added to the given year, to find the Golden Number.

RULE. Divide the given year by 19, the remainder multiply by 11, and the product will be the Epact, if it does not exceed 29; *but if it does,* subtract 30 from it as often as you can, and the remainder will be the Epact, for it never exceeds 29.

EXAMPLE.

What is the Epact of the Year 1810?

1810 divided by 19, gives 95 for the quotient, and 5 remaining; which multiply by 11 gives 55, from which subtract 30, remains 25 the Epact for 1810.

To find the Moon's Age.

To the Epact add the day of the month, and the Fpact or number for the month; the sum, if it does not exceed 30, is her age; but if it docs, subtract 30 from it as often as you can, and the remainder is her age.

NOTE. The Epact, or number for each month, is found thus: divide the number of days contained between the 1st of January and the 1st day of any month, by $29\frac{1}{2}$, the remainder will be the number for that month.

Required the Number or Epact for Sept. 1810?

The number of days contained between the 1st of January, 1810, and the 1st of Sept. are 243 days, divided by $29\frac{1}{2}$, gives 8 for the quotient, and 7 for the remainder, which is the number sought; and so for any other month.

EXAMPLE.

Required the Moon's Age, Feb. 15, 1810.

Day of the month	15
Epact	25
Number for the month	2
	30)42(1
	30
Moon's age	12

Numbers for the months are nearly as follow:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
In common years	0	2	0	2	2	4	4	6	7	8	9	10
In leap years	0	2	1	3	3	5	5	7	8	9	10	11

To find the Moon's Southing on any Day of her Age.

Since the sun returns to the meridian he has left in the space of 24 hours, and the moon in about 24 hours 49 minutes; therefore, if the moon leaves the meridian at the same time that the sun does, on any day, the next day she will come to the meridian 49 minutes after him, falling back about 49 minutes every day; whence, to find the time of the moon's southing, or coming to the meridian on any day, we have this easy RULE:

Multiply the day of her age by 49, and divide the product by 60, the quotient is the hours, and the remainder the minutes after noon when she souths Or, which is rather easier, and in many respects sufficiently exact for the mariner's purpose; multiply the

moon's age by 4, and divide the product by 5, the quotient is the hours, and the remainder multiplied by 12, gives the minutes after noon when she is upon the meridian; but if this time exceeds 12, subtract 12 hours from it, and the remainder is the time of her southing in the morning.

N. B. From the full moon to the change she comes to the meridian, or souths, in the morning; but from the change to the full, in the after noon.

EXAMPLE.

Required the Moon's Southing, July 2, 1810.

The Epact is	25
Number for the month is .	4
Day of the month	2
	30)31(1
Moon's Age	1=49 min.

Hence it appears that the moon comes to the south at 49 minutes after noon.

To find the Time of High-Water on any Day of the Moon's Age at any Place.

RULE. To the time of the moon's southing on the given day, add the time of high-water at the full and change, at the given place, taken from the Table; the sum is the hour past noon on the given day when it is high-water at that place; and if this hour

EXAMPLE II.

At what time will it be High Water at London, August 18, 1810?

	19)1810(95
	100
	5
× by	11
	30) 55 (1
Epact	25
No. of Month	7
Day of Month	18
	50
Subtract	30
Moon's Age	20
Multiply by	4
Divide by	5) 80
Moon's Southing	16 Hours
Time at London	2 46
Afternoon	18 46
Subtract	12
In the Morning	6 46

So that it is high-water at 46 min. after 6 in the morning; and by adding 12 hours 24 minutes, the sum gives the time of the next high-water.

EXAMPLE III.

Required the Time of high-water at Dover, Oct. 17, 1810.

Epact	25
No. of Month	8
Day of Month	17
÷ by	30)50(1
Moon's Age	20
Multiply by	49
÷	by 6|0)98 0
Moon's Southing	16 20 min.
Time at Dover	10 50
	27 10
	24
Afternoon	3 10

Here it is 10 min. past 3 o'clock in the afternoon.

EXAMPLE IV.

Required the Time of high-Water at Aberdeen on the 18th of June, 1810.

Epact	25
No. of Month	4
Day of Month	18
÷ by	30)47(1
Moon's Age	17
× by	4
÷ by	5)68(3 rem.
	. . 12
In the Morning	13 36
Time at Aberdeen	12 45
	26 21
	24 0
H. W. Morning	2 21

Coming into a Port and finding that it is High Water at a certain Hour, to know when it is High Water there on Full and Change Days.

RULE. Subtract the time of high-water from the moon's southing on that day, but if required add 12 hours, the remainder will be the time of the flowing, on the full and change, at that place.

ethod of finding the time of high-water, at times, v
rs wide of the truth ; even if the moon's southing be c
d ; for the floods do not always happen at the same c
me from each other, but at different distances, acco
times of the moon's age, or as the waters are acted up
n or difference of the attractive forces of the sun a
also on account of winds and storms, even when out
therefore pilots, and all concerned, would do well to u
ing method, which will in general give the time of hig
rer the truth, when the tides are not greatly influenc
nd.

showing the Day of the Month Hour of the Day when it is New by Astronomical Calculation.

1810		1811		1812		1813	
D.	H.	D.	H.	D.	H.	D.	H.
5	4	24	6	13	20	2 31	5 21
3	14	22	16	12	8		
						2	10

A Table of Corrections to be added to the Moon's Age to find her Southing.

Ds.	H.	M.	Ds.	H.	M.
1	0	36	16	0	45
2	1	11	17	1	19
3	1	46	18	1	54
4	2	21	19	2	30
5	3	1	20	3	11
6	3	44	21	3	56
7	4	37	22	4	51
8	5	40	23	6	0

To find the Time of High-Water.

Look for the moon's age in the Table of Corrections, the hours and minutes opposite to which being added to the time of high-water, on the change and full days, at any place, will, if it does not exceed 12 hours, give the time of high-water there in the afternoon of the given day; but if it does exceed that number, take 12 from it, and the remainder will show the time of high-water in the morning.

EXAMPLE I.

At what Time will it be High-Water at London, April 5, 1810?

In April, I find it was new-moon the 4th day; and, reckoning forward to April 5, gives 1 day for the moon's age.

Against 1, in the Table of Corrections, stand 36 minutes, to which add 2 hours 46 minutes, the time of high-water at London on the full and change days, and that gives 3 hours 22 minutes, the time of high-water at London in the afternoon.

EXAMPLE II.

Required the Time of High-Water at Dover, Dec. 16, 1810.

In November, I find it was new-moon the 26th day; reckoning forward from the last new-moon, Nov. 26 to Dec. 16, I find the moon's age is 20 days; against 20 in the Table of Corrections stand 3 hours and 11 minutes. This, added to 10 hours 50 minutes, the time of high-water on full and change days at Dover, gives 14 hours 1 minute; from which I take 12, and the remainder 2 hours 1 minute is the time of high water in the morning at Dover on the given day.

EXAMPLE III.

What Time will it be High-Water at Torbay, May 6, 1810?

By the Table it was new-moon on the 3d day, and reckoning forward to the 6th, I find there are three days completely past. Against 3 in the Table of Corrections, stand 1 hour 46 minutes, which, added to 6 hours, the time of high-water at Torbay on full and change days, gives 7 hours 46 minutes, the time of high-water in the afternoon on the above day.

In like manner may the time of high-water be found at any other place.

If the place be any distance east or west of Greenwich, the long. must be reduced into time; and if it be east long. at the place, subtract it from Greenwich time; but if west long. add it, to find the corresponding time at the ship, or place, remembering always to reckon the time from the preceding noon.

EXAMPLE I.

When it is Noon at Greenwich, what Time is it 60° or Four Hours to the Eastward of Greenwich?

Twenty-four hours less 4 hours is 8' A. M. on the day before at Greenwich. And 8 hours A. M. at Greenwich, is noon 60°, or 4 hours, E. of Greenwich.

EXAMPLE II.

What is Greenwich Time when it is Noon 75°, or Five Hours, West of Greenwich?

To 0 or meridian, add 5 hours, gives 5 hours P. M. at Greenwich. And 5 hours P. M. at Greenwich, is noon 75° W. of Greenwich.

A Table where the Corrections are to be added to the Time of High-Water on the New and Full Moon to give the Time of High-Water on any other Day.

Interval of Time:		Af. New and full Moon.		Bef. First and Third Quarters.		Af. First and Third Quarters.		Bef. New and full Moon.		Interval of Time.	
D.	H.	H.	M.	H.	M.	H.	M.	H.	M.	D.	H.
0	0	0	0	5	6	5	6	0	0	0	0
0	6	0	8	4	51	5	22	11	51	0	6
0	12	0	17	4	37	5	40	11	42	0	12
0	18	0	26	4	23	6	0	11	33	0	18
1	0	0	36	4	9	6	20	11	23	1	0
1	6	0	45	3	56	6	39	11	13	1	6
1	12	0	54	3	44	6	58	11	3	1	12
1	18	1	2	3	32	7	18	10	53	1	18
2	0	1	11	3	21	7	37	10	43	2	0
2	6	1	19	3	11	7	56	10	32	2	6
2	12	1	28	3	1	8	14	10	21	2	12
2	18	1	37	2	50	8	31	10	9	2	18
3	0	1	46	2	40	8	47	9	56	3	0
3	6	1	54	2	30	9	2	9	44	3	6
3	12	2	3	2	21	9	17	9	31	3	12
3	18	2	12	2	12	9	31	9	16	3	18
4	0	2	21	2	3	9	44	9	2	4	0

To find the Time of High-Water.

From page I. of the month in the Nau. Alm. take out the time of the phase of the moon answering nearest to the given day, which reduce to the meridian of the place by subtracting the long. of the place in time, if it be west, and adding it if it be east: then, under the nearest phase, at the top of the Table, and opposite the

difference between this reduced time and the noon of the given day, is the correction to be added to the time of high-water on the new and full moon at the given place, to find the time of high-water on the given day.

EXAMPLE I.

Required the Time of High-Water at Portsmouth, on the 21*st of June*, 1810.

	D.	H.	M.
The nearest phase to the 21st of June is 3d quarter	23	10	47
Day of month — — — —	21		
Diff. of time before the 3d quarter — —	2	10	47
Between 2 d. 6 ho. and 2 d. 12 ho. the equation is +		3	3
Flows at Portsmouth — — — —		11	36
As it is past the full, gives high-water 2 h. 39 min. A. M. =		14	39

EXAMPLE II.

What Time is it High-Water at Portsmouth the 1*st of March*, 1810?

	D.	H.	M.
To March the 1st the nearest phase is 3d quarter Feb.	26	8	37
March the 1st may be called — — Feb.	29		
Diff. of time after the 1st quarter — —	3	8	37
The equation for 3 d. 8 ho. 37 min. is +		9	9
Flows at Portsmouth — — —		11	36
High-water 8 ho. 45 P. M. = — —		20	45

EXAMPLE III.

Required the Time of High-Water the 12*th of Dec.* 1810, *at Halifax, Nova Scotia, Long.* 63° 28′ W. *where it flows* 7 *h.* 30 *m.*

	D.	H.	M.	S.
Time from noon of full-moon at Greenwich —	10	19	29	
Long. of Halifax 63 28 in time = — —	—	4	13	52
Time of full-moon at Halifax — —	10	6	6	8
Given day — — — —	12			
Interval of time past the full-moon — —	2	6	6	8
Correction from the Table for the interval = +		1	19	
Time of high-water new and full at Halifax —		7	30	
High-water at Halifax the 10th of July —		8	49 A.M.	

But to find the time of the next high-water find the diff. of equation for the next 12 hours, which added to the time of the last *high-water*, gives you the time required.

S 2

OF THE

LOG-LINE AND HALF-MINUTE GLASS,

AND HOW TO

CORRECT THE DISTANCE GIVEN BY THEM.

THE log is a flat piece of wood like a flounder, or of the figure of a quarter of a circle, having its circular side loaded with lead sufficient to make it swim upright in the water. To this log is fastened a long line of about 150 fathoms, called the log-line, which is divided into certain equal spaces, called knots, each of which ought to bear the same proportion to a nautical mile (60 of which make a degree) that half a minute does to an hour, that being the time allowed for the experiment.

They are called knots, because at the end of each of them there is a piece of twine with knots in it, reeved between the strands of the line; these pieces of twine show how many knots run out in half a minute, and consequently the ship's rate of sailing per hour.

Mr. NORWOOD, and several other able mathematicians, have found that a degree of a great circle upon the earth contains about 367,200 English feet, therefore a nautical mile being $\frac{1}{60}$ part of 367,200 feet, that is, 6120 feet, and since half a minute is $\frac{1}{120}$ part of an hour, the length of the knot on the log-line ought to be the $\frac{1}{120}$ part of 6120 feet, or 51 feet. (In the Requisite Tables published in 1802, the sea-mile is accounted 6078 feet.) But as, for the most part, the ship's way is found, by experience, to be really more than that given by the log, and as it is safer to have the reckoning before the ship than after it, therefore 50 feet may be taken as the proper length of each knot, and these knots subdivided into ten fathoms, each of five feet, which is certainly the best adapted for practice, and will correspond with all the tables and instruments used in navigation, as they are decimally divided, and, consequently, the ship's run determined with greater ease and certainty. But some experienced commanders find, that the allowing 50 feet to a knot generally makes the ship ahead of the reckoning; and to avoid danger mostly divide the log-line into knots of 7 or 7½ fathoms of 6 feet each, to correspond with a glass that runs 28 seconds. Others again divide the seconds the glass runs by 4, and take the quotient for the distance in fathoms between the knots: which last method I have used for 40 years, and always found it answered; but certain it is, that, whatever length the knots are, the most convenient way is to divide them into tenths.

In hot or dry weather, the glass runs out faster than in moist or

rainy weather; therefore care should be taken to try what number of seconds the glass runs.

The knots commonly begin to be counted at the distance of 10, 12, or 15 fathoms from the log, according to the largeness of the ship, that so the log may be out of the ship's wake when it is thrown overboard, before they begin to count, lest the eddies should suck the log after the ship; and for the most ready discovery of this point of commencement, there is commonly fastened at it a piece of red rag; that part of the line between the red rag and the log is called the stray-line.

The log and log-line being duly prepared and hove overboard from the lee quarter, and the line veered out (by the help of a reel which turns easy, and about which it is wound), as fast as the log will carry it away, or rather as fast as the ship sails from it, will show how fast the ship has sailed in the given time, or rate of sailing per hour.

The experiment for finding the velocity of the ship is called heaving the log.

Care should be taken to veer out the line as fast as the log takes it, for if the log is left to turn the reel of itself, the log will come home, and deceive you in the reckoning.

In king's ships, India ships, and some others, the log is hove every hour; but in coasters, and those using short voyages, every two hours.

Here the ship is supposed to move with equal velocity between the times of trying the experiment. But if the gale has not been the same during the whole hour, or time between heaving the log; or if there have been more sail set, or any handed, that so the ship has run more or less in any part of the hour than she did at the time of the experiment; or if it should fall little or more wind at that time; there must be allowance made for it according to the discretion of the artist. Sometimes, too, when the ship is before the wind, and a great sea setting after her, it will bring home the log; in such cases it is customary to allow one mile in ten, and less in proportion, if the sea be not so great.

Care should also be taken to measure the log-line pretty often, lest it stretch, and deceive you in the distance.

The like regard must be had, that the half-minute glass be just 30 seconds, otherwise no account of the ship's way can be kept; to prove which, if there be no stop-watch at hand, let a plummet, of any form or weight, be fastened to a silk string or thread, with a loop to hang on a small pin or nail fastened in any place, so that the plummet may swing freely; let it be $39\frac{1}{8}$ inches from the end of the loop to the middle of the plummet, and the plummet caused to swing; each of those swings will be a true second of time, always counting every time it passes the perpendicular let fall from the pin, and every time it passes from the perpendicular to the utmost swing will be half a *second*.

How to correct the Distance given by the Log-Line and Half-Minute Glass.

The distance given by the log may be wrong on three accounts, *viz.* by an error in the glass, an error in the log-line, or an error in both; for correcting of which take the following cases:

CASE I.

When the log-line is truly divided, and the glass is faulty.

RULE. Say, as the seconds run by the glass are to 30 seconds, so is the distance given by the log to the true distance.

EXAMPLE I.

Suppose a ship runs at the rate of $7\frac{1}{2}$ knots in the time the glass runs out, but measuring the glass I find it runs 34 seconds; what is the true rate of sailing?

As 34 : 30 : : 7,5 : 6,6 miles, the true distance sailed in an hour.

EXAMPLE II.

Suppose a ship runs at the rate of $6\frac{1}{2}$ knots, but measuring the glass I find it runs only 25 seconds; required the true rate of sailing.

As 25 : 30 : : 6,5 : 7,8 miles, the true distance sailed in an hour.

CASE II.

When the glass is true and log-line faulty.

RULE. Say, as 50 feet is to the distance measured between knot and knot, so is the distance run by the log to the true distance.

EXAMPLE I.

Suppose a ship runs at the rate of $6\frac{1}{4}$ knots in half a minute, but, measuring the space between knot and knot, I find it to be 56 feet; required the true rate of sailing.

As 50 : 56 : : 6,25 : 7 miles, the true distance sailed in an hour.

EXAMPLE II.

Suppose a ship runs at the rate of $6\frac{1}{2}$ knots in half a minute, but measuring the space between knot and knot, I find it to be only 44 feet; required the true rate of sailing.

As 50 : 44 : : 6,5 : 5,72 miles, the true distance sailed in an hour.

CASE III.

When both the log-line and glass are faulty.

RULE. Multiply thrice the measured length of a knot by the distance run by the log, the product divided by 5 times the measured time of the glass will give the true distance run.

HADLEY'S
QUADRANT AND
SEXTANT.

Published by J. Johnson & the rest of the Proprietors July 1, 1806.

EXAMPLE.

Suppose a ship runs 5 knots of a log-line of 45 feet to a knot, while a glass of 25 seconds is running out; what is the true rate of sailing?

The measured length of a knot —	45
Multiplied by — —	3
Gives thrice the measured length of a knot	135
Which multiplied by the distance run per log	5
Product	675

And dividing the product by 5 times the time the glass runs, that is, $5 \times 25 = 125$, the quotient is 5,4, the number of miles the ship runs per hour.

This rule is only a compound of the two former simple ones, which is contracted a little.

When the glass is faulty, the log-line may be divided as in the annexed Table, showing the length of the knots of the Log-line of different glasses.

Second of Glass.	Length of Knots in Feet.
24	40,0
25	41,8
26	43,4
27	45,0
28	46,8
29	48,4
30	50,0
31	51,8
32	53,4
33	55,0
34	56,8
35	58,4
36	60,0

THE DESCRIPTION AND USE

OF

HADLEY's QUADRANT AND SEXTANT.

The principal Parts of the Instruments are,

Fig. I. & III.
- The Index D
- The Index Glass E
- The Horizon Glasses G and F
- The Dark Glasses, or Screens, H
- The Sight Vanes K and G.

The graduated arch BB of the Quadrant contains only 45 de-

grees, or the 8th part of a circle, but it is to be counted as 90°, and so divided, because, by the double reflection, the angle is doubled.

The divisions run 0, 10, 20, &c. to 90, as in the figure; each degree is divided into three parts, of 20 minutes each, which, by the help of the vernier, or divisions on the index, is again subdivided into minutes of a degree, thus:

The index D is a flat bar moveable on the centre of the instrument; that part of the index that slides over the graduated arch, having the first and last divisions thereon corresponding to those on the arch, is called the Vernier or Nonius, and which divides every subdivision on the arch in minutes: thus, 7 divisions on the nonius being divided into 20 parts, it is evident the difference between the first division on the arch and on the nonius is $\frac{1}{20}$ of one of the subdivisions on the arch, or 1 minute, because 7° there is divided into 21 parts, being 1 in 20 more than on the arch. The difference of the first two divisions will be 2′, and the difference of the three first 3, and so on; hence it will arise, that whatever divisions on the vernier and arch cut one another the nearest, the vernier will indicate how many minutes above the next subdivision according as it is numbered to right or left thereof. On the bottom of the index, against the back of the arch, is a screw, made to fix fast the index when required.

The arch, as before observed, is divided into 90 degrees, numbered, ⌽ 10, 20, 30, &c. and each degree into 3 parts, each 20 minutes, and is to be read thus: 1d.—1d. 20m.—1d. 40m.—2d.—2d. 20m.—2d. 40m.—3d. &c. observing to read to the division that the ⌽, or diamond-like point of the nonius, last passed over; then the nonius will give the number of minutes more, to be added to the division last passed by the nonius. Thus, suppose the ⌽ or △ of the nonius has passed over 15 degrees and two parts, or 15d. 40m. and stands somewhere between 15d. 40m. and 16d. then observe what division or line on the nonius coincides with any division or line on the arch, that number on the nonius will be the minutes to be added to 15d. 40m. Suppose 15 on the nonius touches some division on the arch, then 15m. must be added to 15d. 40min. and the angle or altitude measured will be 15d. 55m.

The index glass E is a piece of glass truly ground, silvered on the back, and fixed in a brass frame, perpendicular to the index; its use is to receive the rays proceeding from any object, and reflect them to the horizon glasses F and G; at the back of the brass frame of this glass are two screws, serving to adjust the frame perpendicular to the index.

The horizon glasses F F are smaller pieces of ground glass, one part of which is silvered, and the other part open or unsilvered, in order to look at an object through it; these are set in frames, and placed perpendicular on the limb at F and F; their use is to receive the rays of any object reflected from the index glass, and again to reflect those rays to the eye through the holes of the sight-vanes K and G.

To adjust the Quadrant or Sextant for the Fore Observation.

First, the index glass must be perpendicular to the plane of the quadrant, which if not, you may thus discover: Hold the plane of the quadrant in a horizontal position, with the index glass near the eye; look right down the quadrant in such a manner as to see the arch of the quadrant direct, and at the same time reflected by the index glass; then, if the arch seen direct, together with its reflected image, appear to be in one line, the index glass is truly adjusted; if not, it must be rectified by means of the screws placed at the back of the index glass: it is easy to discover which way the inclination is, by pressing the index glass with your thumb while you observe the arch.

Secondly, The axis of the horizon glass must be parallel to the axis of the index glass; if not, the error is easily discovered and rectified in the fore horizon glass when the index is adjusted, thus: bring Ⓘ on the nonius nearly to Ⓘ on the graduated arch, and look directly through the sight-vane at the moon or any bright star, so as to see the reflected image in the horizontal glass, and the object at the same time through the unsilvered part; then move the index backwards and forwards slowly, and observe if both images coincide or pass behind one another, which if they do, the axes of both are parallel; which if not, you should nicely adjust by the two screws placed on the top block of the horizon glass, and by the lever on the back of the quadrant or sextant.

But to adjust the instruments by the horizon, hold the instrument horizontal: if the real horizon and that reflected in the quicksilvered part of the horizon glass coincide, it is adjusted; if not, adjust by the two screws on the top of the block of the horizon glass, and then with the instrument vertical by the lever on the back Fig. II. remembering to place Ⓘ on the graduated arch to Ⓘ on the instrument before you begin.

If a small piece of coloured glass set in brass (which I first fixed to a quadrant in 1790) be made to turn round to the sight-vane occasionally to guard the eye, and the screens turned back, the same correction may be made by using the sun instead of the moon or star.

To adjust the Quadrant for the Back Observation.

Find the dip of the horizon for the elevation of your eye in Table VIII., double the dip, and advance the index D as many minutes before 0 degrees on the arch of the quadrant, as are equal to double the dip: screw your index fast: shift the screens for the back observation:—hold the plane of the instrument upright with the arch downwards, look through the vane G, and if the horizon line seen through the unsilvered part of the back horizon glass G coincide with the reflected image of the same, seen through the silvered part of the glass, the quadrant is rightly adjusted; if not, slacken the screw in the middle of the lever behind the back horizon glass G, and turn the glass backwards or forwards,

as required, till the horizon lines coincide, then tighten the screw, and the quadrant is adjusted.

Another way to adjust for the Back Observation.

Take the altitude of the sun's lower limb, by the fore observation, when he is nearly on the meridian; then shift the screens as quick as possible for the back observation: if the upper limb of the sun be level with the horizon (allowing for double the dip) the quadrant is rightly adjusted; if not, move the screws of the back horizon glass G till it is so; repeating the operation till you find the quadrant truly adjusted.

To take the Altitude of the Sun by the Fore Observation.

The sun's image at any time, when not much obscured by clouds, may be seen as reflected from the unsilvered part of the horizon glass, by looking through the hole in the sight-vane; having put the screens down to guard the eye, hold the instrument vertical, and, turning towards the sun, direct the sight to that part of the horizon beneath the sun, and moving the index, you may bring down the red image of the sun towards the horizon: if the sun's image should be faint, you may turn back the screens, and you cannot miss it.

Having brought down the sun's image near the horizon, swing the quadrant backwards and forwards, making your eye the centre of motion, and keep moving the index, at the same time, till the sun's lower edge just touches the horizon, and you will have the apparent altitude of the sun's lower limb upon the arch of the quadrant at that instant. But this altitude is greatest at twelve o'clock, when the sun is on the meridian, from which the latitude is determined; but this apparent altitude requires the following corrections:

The index error, if any, to be added or subtracted.

The dip of the horizon.

The sun's semi-diameter and refraction.

These corrections are necessary to find the true altitude of the sun's centre nearly, the correction of the sun's parallax being so small, that it may always be neglected in determining the latitude.

The back observation is managed the same as the fore observation, only your back must be turned towards the sun, and the screens shifted to the back horizon glass, remembering to subtract the sun's semi-diameter (if the apparent lower limb be taken) and add the dip, subtracting the effect of refraction, and you will have the altitude of the sun's centre.

The correction for the index error is thus: Turn down the small knob of brass placed on the limb, to hinder the index from going off the arch, as it may be in the way. This correction may be accurately estimated by taking the diameter of the sun, or any object before and behind ⦶ on the arch; that is, bring the upper limb of the object to coincide with the lower, and note the angle,

then take it on the extra arch, as it is called; that is, bring the lower limb to coincide with the upper, and note the angle, half the difference of these two angles will be the true correction of the index error.

EXAMPLE.

Suppose the sun's diameter measures 36 on the arch, and 28 on the extra arch. The difference is 8', half which is the error to be subtracted, because the diameter measures more on the arch, or gives the sun's diameter too much; but had the extra arch given the greater angle, the error would have been additive.

To take the Altitude of the Moon.

The moon's altitude may be either taken by the fore or back observation, exactly in the same manner as the sun's altitude, only here you must bring the edge of the moon into contact with the horizon, which is round and well defined, whether that be the upper or under edge: the corrections to be applied to the observed altitude are as follow:

The index error, as before directed, if any; the dip to be subtracted in the fore observation, and to be added in the back observation; the semi-diameter to be found in the Nautical Ephemeris for every noon and midnight, at Greenwich; if very great accuracy is required, this semi-diameter must be corrected for the intermediate time: which being added to, or subtracted from, the observed altitude, will give the apparent altitude of the centre; and the moon's horizontal parallax for every noon and midnight, at Greenwich, is to be found in the Nautical Ephemeris. This must be corrected for the intermediate time; then take the proportional logarithm of the moon's horizontal parallax out of the Nautical Almanack, increase its index by 10, and subtract the log. co-sine of the moon's apparent altitude from the sum; the remainder will be the proportional logarithm of her parallax in altitude; from which take the moon's refraction (Table VII.) and the remainder will be the correction of the moon's altitude, which being added to her apparent altitude, will give the true altitude of her centre.

To take the Altitude of a Star by the Fore Observation.

Set the index at ⊕, and holding the plane of the quadrant vertical, direct the sight to the star, and at the same time look for the reflected image of the star in the silvered part of the horizon glass; move the index a little, which will separate the reflected image from the direct image; the former will be easily distinguished from the latter by its motion, when you stir the index; continue to advance the index, and at the same time follow the reflected image of the star with your eye, directing your sight lower and lower, and changing the *position* of the quadrant or sextant, as the

image of the star descends, till you have brought it down to the horizon: the index will then show the observed altitude of the star. The corrections to be applied to the observed altitude of the star are: the index error, the dip (these two give the apparent altitude); the refraction gives the true altitude; the fixed stars have neither semi-diameter nor parallax worthy notice.

In taking the altitude of a star, or the moon, by night, always get as near the water as possible; in moderate weather a grating may be slung over the ship's side, and an observer sit upon it to take the altitudes; the same may be done to take the altitude of the sun in a hazy horizon; for the nearer the eye is to the surface of the water, the nearer the true horizon will be to the eye.

Advice to Seamen in the Choice of their Quadrants and Sextants.

The joints of the frame must be close, without the least opening or looseness, and the ivory on the arch and nonius inlaid and fixed, so as not to rise at the ends, nor above the plane of the instrument; all the divisions on the arch and nonius must be exceeding fine and straight, so that when the index or nonius is set to any division on the arch, the divisions on the line that coincide may appear distinct; for only the first and last line on the nonius will coincide with the other lines upon the arch, if the quadrant is well divided; likewise try in different parts of the arch, if the nonius, or index plate, cuts regularly in order with those on the arch: if they do not, the divisions are bad, and the quadrant ought to be rejected.

Again, look into the great speculum or index glass slant-ways, holding it about ten or twelve inches from the eye, and observe the image of some distant object; if the image appears clear and distinct in every part of the glass, the speculum is good; but if it appears notched, or drawn with small lines, the glass is veiny, and must be rejected; if more images than one of the same object are seen, it shows that the two surfaces are not ground parallel; the other speculum may be examined in the same manner.

Observe the sun, or a candle, through the dark glasses severally, holding the glass about eight or ten inches from the eye; if they are veiny, the object will appear notched at the edges, but if clear and well defined, the glasses are good.

Quadrants, like watches, may appear well to the eye, and yet be good for little; it is therefore much better to give two guineas and a half, or three guineas, for a good one, that will last a man for life, than purchase those wretched instruments, made up at a low price, which cannot be depended on.

The surprising improvements made in Navigation since the year 1767, when the first Nautical Almanack was published by Dr. Maskelyne, the present Astronomer Royal, are beyond the most sanguine expectations; and though several nations have contributed towards this important end, the English have (by the encouragement held out by parliament, and the great improve-

ments made in nautical instruments and calculations) surpassed them all; so that by the help of the improved sextant, the Nautical Almanack, and the Tables contained in this book, a skilful and expert observer can determine the longitude to a degree of accuracy that people unacquainted with the operation would scarcely think possible.

Hadley's sextant is constructed on the same principles as the quadrant; but as it is used to measure the angular distance between the sun and moon, or the moon and a star, in order to determine the longitude, the arch is extended to 120°, for the purpose of measuring their distance when greater than 90°; it is also provided with some appendages not generally annexed to a quadrant, in order to take the observation with greater accuracy.

On the adjoining plate is represented a sextant, the frame of which is generally made of brass; the arch BB is divided into 120°, each degree into three parts, of course equal to 20 minutes, which are again subdivided by the nonius into every half minute, or 30 seconds; every second division, or minute, on the nonius, is cut longer than the intermediate ones; the nonius is numbered at every fifth of these longer divisions, from the right towards the left, with 5, 10, 15, and 20, the first division towards the right hand being to be considered as the index division.

This is the general way of graduating sextants; but for obtaining greater accuracy, some are divided as follow: the arch contains 120°; each degree is subdivided into 4, of course equal to 15′, which are again subdivided by the nonius into 15″; every fourth division or minute of the nonius, is longer than the intermediate ones; the nonius is numbered at every fifth of these long divisions, from the right towards the left, with 5, 10, 15; the first division towards the right hand is to be considered as the index division. The present mode of dividing the nonius of the sextant is thus: (beginning from the right hand towards the left) by taking fifteen divisions on the nonius, equal to fourteen on the arch, consequently one division on the arch will exceed one on the nonius by $\frac{1}{15}$, that is, by $\frac{1}{4}$ of a minute, where the degrees on the arch are subdivided into $\frac{1}{4}$, equal to 15 minutes

The nonius, till very lately, was divided as the quadrant.

In order to observe with accuracy the contact of the limbs of any two objects, an adjusting-screw, L, is added to the index, by which it may be moved with greater regularity than it can by the hand; but this screw does not act until the index is fixed by the finger-screw M. Care should be taken not to force the adjusting-screw when it arrives at either extremity of its adjustment. When the index is to be moved any considerable quantity, the screw M, at the back of the sextant, must be loosened; but when the index is brought nearly to the division required, this back screw should be tightened, and the index moved gradually by the adjusting-screw.

N. B. Many *quadrants have* an adjusting-screw.

In many sextants the lower part of the index glass, or that nearest the frame, is silvered as usual, and the back surface of the upper part painted black; also a screen is fixed at the base of the index glass, turning on its axis, and may be placed over the silver part when the sun's rays are strong, in which case the image is reflected from the polished surface of the upper part, and the error, which might probably arise from the planes of the glasses not being parallel, is thereby avoided.

There are several coloured glasses at H, each of which is set in a different frame, turning on a centre; they are used to screen the eye from the brightness of the solar rays, and the glare of the moon; and may be used separately or together, as occasion requires.

There are other such glasses placed behind the horizon glass at F, to weaken the rays of the sun or moon when they are viewed directly through the horizon glass; the paler glass is sometimes used in observing altitudes at sea, to take off the strong glare of the horizon.

The sextant is furnished with a plain tube, without any glasses; and to render the objects still more distinct, it has two telescopes, one representing the objects erect, or in their natural position, the other showing them inverted; it has a large field of view, and other advantages; a little use will soon accustom the observer to the inverted position, and the instrument will be as readily managed by it as the plain tube alone. By a telescope the contact of the images is more perfectly distinguished; and by the place of the images in the field of the telescope it is easy to perceive whether the sextant is held in the proper plane for observing. By sliding the tube that contains the eye-glasses in the inside of the other tube, the object is suited to different eyes, and made to appear perfectly distinct and well defined.

The telescopes are to be screwed into a circular ring, at K; this ring rests on two points against an exterior ring, and is held thereto by two screws; by turning one and tightening the other, the axis of the telescope may be set parallel to the plane of the sextant. The exterior ring is fixed on a brass stem that slides in a socket, and by means of the screw S, at the back of the sextant, it may be raised or lowered so as to move the centre of the telescope to point to that part of the horizon glass which shall be judged the most fit for observation.

A circular head, containing a plate, in which there are three coloured glasses, and a fourth that is open, sometimes accompanies this sextant. This head is to be screwed on the eye-end of the tube, or on that of either telescope. The edge of the plate projects a little beyond the head on one side, and is moveable by the finger, so that the open ring, or any of the coloured glasses, may be brought between the eye-glasses of the telescope and the eye.

To these are added, a small screw-driver to adjust the screws,

and a magnifying glass to read off the observation with greater accuracy.

The Adjustments of a Sextant are to set the index and horizon-glasses perpendicular to the plane of the instrument, and their planes parallel to each other; by the same method as the quadrant, only screwing on the plain tube or telescope; also to set the axis of the telescope parallel to the plane of the instrument; each of these particulars must be examined before an observation is taken, and the adjustments, if requisite, be made.

For correcting the index error, see the rules for adjusting Hadley's Quadrant.

To set the Axis of the Telescope parallel to the Plane of the Sextant.

In measuring angular distances, the line of sight, or axis of the telescope, should be parallel to the plane of the instrument, as a deviation in that respect will occasion a considerable error in the observation; and this is most sensible in large angles. To avoid which, an inverted telescope is used, in whose field there are placed two wires parallel to each other, and equidistant from the centre; to which are sometimes added two others, at right angles to these, but parallel to each other. By means of these wires the adjustment may be made thus: screw on the telescope, and turn the tube containing the eye-glass, till the wires are parallel to the plane of the instrument; then take two objects, as the sun and moon, or the moon and a star, whose angular distance must not be less than 90°, because the error is more easily discovered when the distance is great; bring them exactly into contact on the wire which is nearest the plane of the instrument, and fix the index; then, by altering a little the position of the sextant, bring them to appear on the wire farthest from the plane of the instrument; if they remain still in contact, the axis of the telescope is parallel to the plane of the sextant; but if the limbs of the two objects appear to separate at the further wire, it shows that the object-end of the telescope inclines towards the plane of the sextant; this must be rectified by tightening the screw nearest the sextant, which is attached to the ring that holds the telescope, having previously slackened the crew farthest from it. If the images over-top each other when brought to the wire farthest from the sextant, the object-end of the telescope is inclined from the plane of the sextant, and must be rectified by slackening the screw nearest the sextant, and tightening the other. Repeat this operation till the contact be rendered perfect on both wires, the axis of the telescope will then be truly adjusted.

To observe the angular Distance between the Sun and Moon.

Screw on the inverted telescope, placing the wires parallel to the plane of the instrument; then turn down the screens, according to the brightness of the sun; place the index at O on the arch, and if the *sun's image* be very bright, turn up the screen before

moon's nearest limb; then fix the index of the
sextant, and make the contact perfect by means of th
screw; at the same time move the sextant slowly,
axis of the telescope the centre of motion, by whic
objects will pass each other, and the contact be mor
discriminated. The index will show the observed di
sun and moon's nearest limbs, which you will read off
nifying glass.

Second Method.

It will perhaps be more easy for those who are not
to make observations of this kind, to find the distance
setting the index forward to it, to look directly towar
holding the instrument as before; the sun will then a
in contact with it, and is to be made perfect by the m
mentioned. In the Nautical Ephemeris, the distanc
and moon is set down for every three hours of time a
on such days as the moon is not more than 120°, nor
distant from the sun, and may be found for any inter
by taking proportional parts; from these distances y
pute roughly their distance at the time of observation
the ship's longitude into time by Tab. XVI. and add
of observation, if the longitude be west, but subtract
gitude be east, the sum or difference will give the ti
wich; then, by the Ephemeris, find the distance n
time, from which subtract 30 minutes for the sun and
diameters, and the remainder will give the distance of
limbs at the time of observation.

If a number of observations are to be taken, the f
thod will not be found unacceptable: Having broug
into contact, as before directed, and noted down th
angular distance, advance or draw back your index

as before directed; then move the index forward, till the reflected image of the moon is seen in the telescope; by moving the instrument slowly up and down, the moon will appear to rise and fall by the star. The round and well defined limb of the moon, whether it be nearest or farthest from the star, must be brought into contact with it. When the object to be seen by reflection is to the right hand of that to be seen by direct vision, the instrument is held with its face upwards; but when the object to be seen by reflection is to the left hand of that seen directly, the instrument is held with its face downwards. Having brought the objects into contact, the nonius will show the observed angular distance.

If the distance between the moon and one of the stars set down in the Ephemeris for finding the longitude, is to be observed, their distance may be roughly calculated as before directed, to which set the index; then look through the telescope, and direct the sight to the star, which is generally a bright one, and lies in a line nearly perpendicular to the horns of the moon, either to the eastward or westward, as denoted in the Ephemeris; then, holding the instrument in the plane of the two objects, give it a slow motion up and down, and if the moon's image come in the field of the telescope, it is a proof you have taken the right star, as no other in that direction will correspond in distance to it.

After the distance is observed between the sun and moon, by a sextant or quadrant, there still remains to be made some corrections to obtain the true distance; the corrections are those for parallax, refraction, and semi-diameter.

The dip of the horizon is an angle made with the height of the eye of the observer and the visible horizon, and which makes the angle of celestial objects appear higher than they really are by the amount of the correction found in Table VIII. and which is to be subtracted from all altitudes.

PARALLAX.

The parallax of the sun and moon is the *difference of the altitude* of either object, if observed at the same moment of time from the *centre*, and from the *surface* of the earth. The parallax of the heavenly bodies is greatest when in the horizon; hence called the horizontal parallax. That of the moon is set down in the Nautical Almanack for every noon and midnight, but may be found for any intermediate time by taking proportional parts. The sun's mean parallax being only 8″. 6, is seldom attended to in nautical calculation, except when his altitude is taken to determine the true time, or the angular distance to determine the longitude. The stars, on account of their great distance from the earth, have no sensible parallax; the parallax of the sun and moon causing them to appear lower than they really are, it is evident this correction must be added to the apparent altitude of the sun and moon, in order to obtain their true altitude. This will be better illustrated by the plate facing page 146. Let C represent the centre of the

earth; a, o, e, part of the moon's orbit; b, d, g, part of the sun's orbit; l, k, part of the starry heavens. Now, to a spectator at m upon the surface of the earth, let the moon appear at e, in the horizon of m, and it will be referred to f; but if viewed from the centre c, it will be referred to h. The difference between these places, or the arch f, h, is called the horizontal parallax, and the angle m, e, c, the paralactic angle. The parallax will be greater or less, according to the distance of the objects from the earth; thus, the parallax f, h, of e, is greater than the parallax f, n, of g; and with respect to the same object, it is evident, when it is in the horizon, the parallax is greatest, and that it diminishes as the object approaches the zenith, where it vanishes. Thus the horizontal parallax of e and g is greater than the parallax in altitude of o and d; but the objects a and b, as seen from m, the surface, or c, the centre, appear in the same place, l, or the zenith.

Having the earth's semi-diameter, and the parallax of any of the planets, their distance may be found thus: As the tangent of the parallax: is to the earth's semi-diameter in miles: : so is radius: to the distance.

Having the distance, the parallax in altitude is found thus: As the distance: is to radius: : so is the earth's semi-diameter: to the tangent of the parallax.

REFRACTION.

From various experiments it hath been found that the rays of light passing through the atmosphere, are bent out of their straight course into an elliptic curve-line, from whence it follows, that all heavenly bodies, except when they are in the zenith, appear higher than they ought to do, and the more so the nearer they are to the horizon, where they are nearly 33 miles. This apparent elevation of the heavenly bodies above their true height is called the Refraction, therefore all apparent altitudes observed, must (after the dip has been allowed for) be reduced to their true altitudes by the correction found in Table VII. which must be subtracted from the apparent altitude, or added to the zenith distance, in order to obtain the true altitude.

Now, since parallax makes all objects appear lower than they really are, and refraction makes them appear higher than they are, it is evident that the true altitude of an object cannot be obtained without correcting the observed altitude for the difference of these two suns.

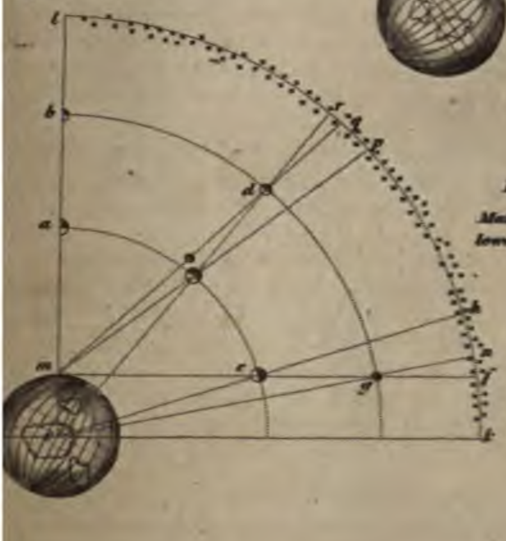
SEMI-DIAMETER.

The moon's semi-diameter is smallest when in the horizon, and increasing as she approaches the zenith, where it is greatest; as she is then nearer the spectator by the earth's semi-diameter. This augmentation is set down in Table X. Another reason of the *apparent* augmentation and diminution of the moon's semi-diameter is, that she moves round the earth in an orbit not circular, but

REFRACTION.

The Rays of Light passing thro-ugh the Atmosphere make Objects appear higher than they are.

DIP OF THE HORIZON.



PARALAX.

Makes Objects appear lower than they are.

Published by J. Johnson & the rest of the Proprietors July 1. 1806.

elliptic, and is consequently, at different parts of her orbit, nearer to, or farther from the earth, which occasions an apparent augmentation or diminution of her semi-diameter; on which account her semi-diameter and horizontal parallax for every noon and midnight are set down, page 7, of the month, in the Nautical Almanack, and may be found for any intermediate time by taking proportional parts.

It is evident, that to obtain the true angular distance, the observed distance must be corrected for the semi-diameter of the objects. If the nearest limbs of the sun and moon are observed, the sum of the semi-diameters must be *added*; if the farthest limbs are observed, the sum must be *subtracted* from the observed distance, to obtain the distance of their centres. The same rules hold good in respect to adding or subtracting the moon's semi-diameter, according as her nearest or farthest limb is used when the observation is made between the moon and a star, observing that the star has no semi-diameter.

To work an observation, or to find the Latitude of a Place, by the Tables of the Sun or Star's Declination, and the Zenith Distance.

The latitude of any place is its distance from the equator, either north or south, counted in degrees, &c. upon an arch of the meridian, contained between the zenith and the equator.

The zenith is that point directly over our heads, and is 90 degrees distant from the horizon.

The zenith distance is the distance of any object from the point directly over our heads, which is always the complement of the altitude; it is said to be south, if the sun or star be south, and north, if the sun or star be north of the observer.

To the observed altitude add the difference between the semi-diameter and the dip, the sum will be the apparent altitude of the sun's centre; but must be subtracted if a back observation is used.

From the apparent altitude subtract the refraction, the remainder will be the true altitude of the sun's centre: this being subtracted from 90 degrees, gives the true zenith distance, with which, and the declination, the latitude is found by the following rules.

See Globe, facing page 46.

NOTE. For the dip and refraction, see Tables 8 and 7.

1st. When the sun or star is in the zenith, the declination is the latitude; and is of the same name as the declination, north or south.

2d. When the sun or star is on the equator, consequently hath no declination, the zenith distance is the latitude of the place: if the zenith distance be south, the latitude is north; but if north, the latitude south.

3d. When the zenith distance is north, and declination north, if they be both equal, you are on the equator, therefore in no latitude.

ı the zenith distance is south, and declination south, zenith distance is equal with the declination, you are or.

oing need no examples.

when the zenith distance is south, and the declina- he declination added to the zenith distance gives the ı.

the zenith distance is north, and the declination clination added to the zenith distance gives the lati-

the zenith distance is south, and the declination zenith distance is more than the declination, subtract on from it, and the remainder gives the latitude north.

the zenith distance is north, and the declination zenith distance be more than the declination, subtract on from the zenith distance, the remainder is the ı.

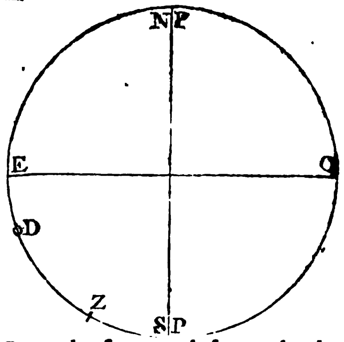
the zenith distance is north, and the sun hath north the zenith distance being less than the declination, he zenith distance from the declination, gives the ı.

the zenith distance is south, and declination south, distance is less than the declination, the zenith dis- ted from the declination gives the latitude south; for these two last cases, the observer is between the sun

EXAMPLE II.

Suppose, on the 14th Jan. 1810, the meridian altitude of the sun's lower limb was found to be 46° 20′ north, the elevation of the eye being 18 feet. Required the latitude?

		° ′ ″	
Sun's observed altitude		46 20 0	North.
Semi-dia. 16′ 0″; Dip 4 0; Diff. 12 0	Add	0 12 0	
Apparent altitude	-	46 32 0	North.
Refraction	- -	0 1 0	
Sun's true altitude	-	46 31 0	
		90 0 0	
Zenith distance	-	43 29 0	North.
Declination	-	21 22 0	South.
Latitude	- -	64 51 0	South.

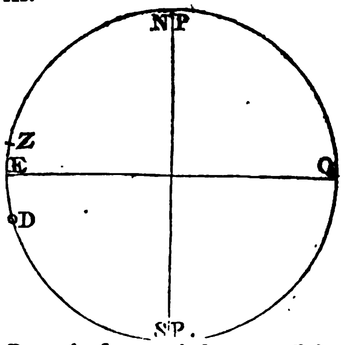


Draw the figure as before; take the declination, 21° 22′, from the line of chords; set off from E towards the south pole to D; take the zenith distance on the line of chords, and set it from D to Z; then will E Z, measured on the same line of chords, be the latitude required.

EXAMPLE III.

Suppose, on the 20th Jan. 1810, the meridian altitude of the sun's lower limb to be 42° 30′ south, the eye being elevated 18 feet above the water. Required the lat.

Sun's observed altitude.		42 30 0	South.
Semi-dia. 16′ 0″; Dip 4 0	Diff.	0 12 0	
Sun's apparent altitude		0 42 42	
Refraction	. - -	0 1 0	
Sun's true altitude	-	42 41 0	
		90 0 0	
Zenith distance	-	47 19 0	South.
Declination	. -	20 12 0	South.
Latitude	- - -	27 7 0	North.

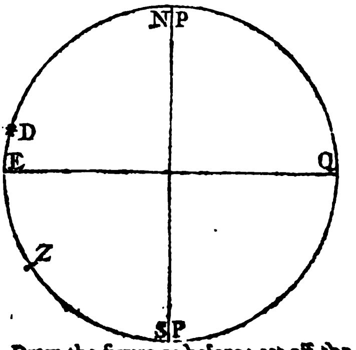


Draw the figure as before; set off the declination, 20° 12′, from E towards the south pole to D. Secondly, set off the zenith distance, 47° 19′, contra from D towards the north, to Z; then will EZ measure on the line of chords 27° 7′, the latitude.

EXAMPLE IV.

Suppose, in 1810, the altitude of the star Aldebaran, when on the meridian, be found 40° 27′ north, when the decl. is 16° 7′ 8″ north, the eye being elevated 18 feet above the sea. Required the lat.?

		° ′ ″	
Observed latitude	-	40 27 0	
Dip for 18 feet	-	0 4 0	
Apparent altitude	-	40 23 0	
Refraction	- -	0 1 0	
Star's true altitude	.	40 22 0	North.
		90 0 0	
Zenith distance	-	49 38 0	
Star's declination	-	16 7 8	
Latitude	-	33 30 52	South.



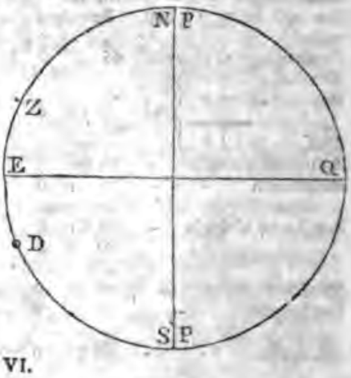
Draw the figure as before; set off the star's declination, 16° 7′ 8″ from E to

he zenith distance 49° 38′, from D to z; then will Z E, measured on s, be 33° 30′ 52″, the latitude required, which is south.

EXAMPLE V.

n's true meridian altitude
outh, and his declination
he latitude is required.

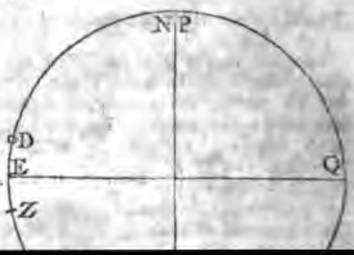
alt.	64° 20′ 0″
-	25 40 0 South.
ract	14 20 0 South.
-	11 20 0 North.



EXAMPLE VI.

e altitude of the sun's cen-
, and the sun's declination,
Required the latitude?

alt.	64° 20′ 0″
-	25 40 0 North.
orth	14 20 0
-	11 20 0 South.



above the horizon: required the latitude in the longitude of 64° east and 64° west.

Sun's obs. alt.	25° 12′S.	Sun's obs. alt.	25° 12′S.
⊙ Semi-dia. 16, Dip 6 } Sum	+ 22	⊙ Semi-dia 16, Dip 6 } Sum.	+ 22
App. alti. -	25 34	App. alti. -	25 34
Refraction -	2	Refrac. -	2
True alti. -	25 32	True alti. -	25 32
	90 0		90 00
True zenith dist.	64 28 N.	True zenith dis.	64 28N.
Dec. 12 March 3 27, Cor. for 64° E. long. From Table XIII. + 4 }	3 31 S.	Dec. 12 March 3 27, Cor. for 64W. long. By Table XIII. — 4 }	3 23 S.
Lat. in	67 59 N.	Lat. in	67 51N.

As the declination in the tables is calculated for the meridian of Greenwich, it is plain that when a ship is to the eastward, and the declination decreasing, it must be more at the ship than at Greenwich; consequently the proportional parts of the daily difference must be added to the declination of that day; but when the ship is to the westward of London, the proportional parts must be subtracted, to find the true declination at the place of observation; but had the declination been increasing, the proportional parts must have been subtracted when to the eastward, and added when to the westward, to obtain the true declination at the ship; whence it follows, that no latitude can be truly ascertained without finding the sun's declination at the place of observation, as above, which is but too often neglected.

Here it may be observed also, that in a back observation, the sun being brought over the observer's head, the upper edge appears to him the lower one; and though the sun appears to the south of him, yet the zenith distance is north. The same may be observed if he is north of the sun. The back observation is seldom used, unless there is a high land, or other obstructions, between the observer and the sun.

The foregoing rules are for observing the sun, or a star, when they are at the greatest altitude, or upon the meridian above the pole; but as in some parts of the earth the sun does not set for several days, and some stars never set, in that case they may be observed when they are at the lowest, or upon the meridian below the pole. To work which observation, take the following

RULE.—Add the complement of declination to the true meridian altitude: the sum is the latitude, of the same name that the declination is of.

Suppose, on the 12th of June, 1810, an observer in a high

northern latitude, 65° west of Greenwich, his eye being 28 feet above the level of the sea, should observe the altitude of the sun's lower limb on the meridian below the pole, to be 8° 15′ south, by a fore observation. Required the latitude?

The sun being observed below the pole, it must have been at 12 hours past noon, at the place of observation; and that place being 65° west of London=4 hours 20′ later than at London, it must be 16 hours 20 minutes past noon at London.

Sun's declin. 12th June,	23° 8′ 27″ N.	
13th ditto,	23 12 14 N.	
Diff. -	0 3 47	
Correc. for 65° west of Greenwich, Tab. XIII.	0° 0′ 33″	Add.
Decl. 12th June	23 8 27	
Correct. declin.	23 9 0 North.	

Sun's observed alt.	8° 15′ 0″
From semi-dia. 16—5 dip, diff.	0 11 0 add.
Apparent altitude	8 26 0
Refraction subtr.	0 6 0
True merid. alt.	8 20 0
Compl. of S.'s dec.	66 51 7
	75 11 7 North.

At sea I took the altitude of the north pole-star, when on the meridian below the pole, and found it 46° 21′. Required the lat.?

Mer. alt. -	46° 21′ 0″
Compl. of decl.	1 41 2 North.
Latitude in	48 2 2 North.

The pole star is the last in the tail of the Little Bear, and is known by two stars always pointing to it, commonly called the Pointers. How to find and know the stars, will be farther elucidated when we come to treat of finding the longitude at sea.

OF THE VARIATION OF THE COMPASS.

THE variation of the compass is an arch of the horizon contained between the meridian of the place and the magnetic meridian, and is either east or west; or it is the number of degrees, &c. the needle's point stands from the true north or south points

of the horizon, reckoned to the eastward or westward, and is readily found from the sun's amplitude or azimuth.

To find the true Amplitude.

The sun's true amplitude is an arch of the horizon, comprehended between the true east or west points thereof, and the centre of the sun at its rising or setting; or it is the number of degrees, &c. the sun rises or sets to the northward or southward of the east or west point of the horizon.

The sun's magnetic amplitude is the number of degrees, &c. the centre is northward or southward of the east or west points of the compass at his rising or setting, and is found with an azimuth compass in the following manner:

Having placed the azimuth compass in a convenient part of the ship, look directly through the sight vanes at the sun's centre; and when the sun's lower edge just touches the horizon, stop the card, by a stop which is placed on the compass for that purpose; then the quantity of degrees and minutes contained between the east or west, and the north or south, points of the compass, will be the magnetic amplitude.

The true amplitude is found either by inspection in the Tables of the Sun's Amplitude, or by calculation, as follows:

RULE. As the sine compl. of the lat. or sec. less radius
Is to radius,
So is the sine of the sun's or star's declination
To the sine of the true amplitude;

which is always of the same name with the declination, whether north or south.

EXAMPLE I.

Suppose the sun's declination to be 10° 43′ S. in lat. 51° 32′ N. I demand the true amplitude.

		Or thus:	
As sine com. lat. 51° 32′	9.79383	Lat. 51° 32′ N. secant	0.20617
Is to radius	10.00000	Decl. 10 40 S. log. sine	9.26940
So is si. sun's dec. 10° 43′ S.	9.26940		
To si. of true amp. 17° 24′	9.47557	True amp. 17° 24′ S. =	9.47557

EXAMPLE II.

In latitude 38° 25′ N. what is the sun's true amplitude when the declination is 18° 59′ N.?

		Or thus:	
As sine com. lat. 38° 25′	9.89405	Lat. 38° 25′ N. secant	0.10595
Is to radius	10.00000	Decl. 18° 59′ N. log. sine	9.51227
So is sine declin. 18° 59′	9.51227		
To sun's true amp. 24° 32′	9.61822	Log. si. 24°32′ true am. N.	9.61822

nd the true Amplitude by the Table of Amplitudes.

r the given declination at the top of the table, and th
the first column on the left hand, in the common angl
, will be the degrees and minutes of the amplitude re

EXAMPLE I.

de 40° N. when the declination was 17° N. required th
amplitude at rising.

eclination 17°, and right against the latitude 40°, stan
true amplitude; which is to be counted from the east to
north, because it is at the sun's rising, and the declina
h; that is, E. 22° 26′ N.

en the latitude is given in degrees, and the declinatio
and minutes, find the declination at the top as befor
arest degrees to the given latitude in the left-hand co
inst which, and under the given declination, stands th
ude; or, if the minutes of the declination be near 30
egree, find the amplitude for the given degrees of de
and the amplitude for one degree above it; add thes
udes together, half the sum will be the true amplitude
exact for practice at sea.

EXAMPLE II.

I would know the sun's true amplitude at his setting, i
°, his declination being 11° 33′ S.

EXAMPLE IV.

Suppose it were required to find the sun's true amplitude at setting, in latitude 49° 20', his declination being 19° 40' N.

Now as the latitude is nearest to 49° and the declination nearest 20°, therefore against latitude 49° and under declination 20°, stands 31° 25' N. the true amplitude; that is, W. 31° 25' N. the declination being north, and at the sun's setting.

To find the true Azimuth.

The true azimuth is an arch of the horizon contained between the meridian of the place and the azimuth circle passing through the centre of the sun or star at the time of observation; or it is the true distance of the sun or star from the true north or south points of the compass.

The magnetic azimuth is an arch of the horizon contained between the magnetic meridian and the azimuth circle passing through the centre of the sun or star when observed; or it is the apparent distance of the sun or star from the north or south points of the compass, either in the forenoon, or in the afternoon, when they are 5°, 10°, 15°, &c. above the horizon, and the less the altitude is, the more exact you may perform the observation.

The magnetic azimuth is found by the compass, in the following manner:

Place the compass in a convenient part of the ship; then move it so that the sights may be directed to the sun's centre; and the shadow of the string will fall directly on the line marked on the plane which joins the sights; then the degree, &c. in the arch intercepted between the end of the index and north point of the card, will give the magnet azimuth required. If the sun does not shine strong enough to give a strong shadow, look through one of the sights, and move the compass till one of the strings cuts the sun's centre, and then the intercepted arch, as before, shows the sun's azimuth, and the like of the star's.

When there is a rough sea, the observation is best made by two persons, and if the card vibrates much, take the middle degree between the limits which the vibration reaches.

When the azimuth is observed, the altitude of the object must be observed at the same time.

Having the latitude of the place of observation, and the sun or star's declination with the true altitude at the time of observation, the true azimuth is found as follows:

RULE. From the half sum of the complement of the latitude, the complement of the altitude, and the sun or star's polar distance, subtract the polar distance, noting the half sum and the remainder. Then add together

The log. sine of the Lat. co ar = co sec. less rad. or
complement of the Alt. co ar = co sec. indexes,

sine of the half sum,
log. sine of the remainder, into one sum.
sum of these four logarithms will give the log.co-sin
rue azimuth, which being doubled, gives the true azi
oned from the north in north latitude, and from th
th latitude.
he polar distance of the sun or star, is their distanc
arest, or elevated pole : and if the latitude of the place
ination of the sun or star, be both north, or both south
mplement of the declination is the polar distance ; bu
de and declination be one north and the other south
ion added to 90° gives the polar distance.

EXAMPLE I.

de 51° 32′ N. the sun's altitude was observed to b
declination being then 16° 37′ N.: required the tru

90° 00′	90° 00′		90° 00′
51 32	Alt. 39 28	Dec.	16 37
	Com. Alt. 50 32	Pol. dist.	73 23
38 28	Sine co ar =	Co-secant less rad.	0.20617
50 32	Sine co ar =		0.11239
73 23			

Co. lat.	47	44	Co-secant	0.13076
Co. alt.	71	20	Co-secant	0.02347
Polar dist.	97	38		
Sum	216	42		
½ Sum	108	21	Log. sine.	9.97734
Polar dist.	97	38		
Remainder	10	43	Log. sine.	9.26940
			Sum	19.40097

½ Sum log. co-si. 59, 53 = 9.70048
2

True azimuth 119 46 from the north.

The following questions are set down for the learner's exercise:

Quest. I. Being at sea, in latitude 40° 38′ N. in the afternoon, the sun's altitude was observed to be 20° 46, when his declination was 17° 10′ S. what was the sun's azimuth at that time?

Ans. 137° 50′ from the north.

Quest. II. What is the sun's true azimuth in lat. 26° 30′ N. in the forenoon, when his altitude is 24° 28, and his declination 22° 40′ N.?

Ans. 75° 48′ from the north point of the compass.

Quest. III. At the island of St. Helena, the sun's altitude was observed to be 30° 22′ in the forenoon, his declination being then 22° 58′ S. required the azimuth at that time.

Ans. 72° 24′ from the south, or 107° 36 from the north.

Quest. IV. What is the bearing of the star Aldebaran at the Cape of Good Hope, when its altitude is 22° 25 ?

Ans. 130° 20′ from the south, or 49° 40′ from the north.

Having found the sun's true amplitude or azimuth by the preceding methods, &c. magnetic amplitude or azimuth by observation, it is evident, that when they agree there is no variation; but when they disagree, then if the true and observed amplitudes be both of the same name, that is, both north, or both south, their difference is the variation; but if the true and observed amplitudes be of different names, that is, one north and the other south, their sum is the variation. Again, if the true and observed azimuths be both on the east, or both on the west side of the meridian, their difference is the variation; but if the true and observed azimuths be one on the east and one on the west side of the meridian, their sum gives the variation; and to know whether the variation is easterly or westerly, observe this general

RULE.

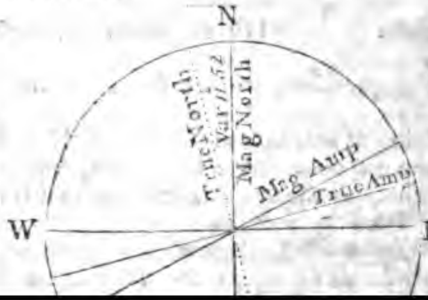
server's face be turned to the sun; then if the tru
azimuth be to the right hand of the magnetic, or ob
ariation is easterly; but if to the left hand, westerly

EXAMPLE I.

he sun's magnetic amplitude at rising is found to b
. but the true is found to be E. 14° 20′ N.; require

From the greater	E. 26° 12′ N.
Take the lesser	E. 14 20 N.
Remains the variation	11 52 E.

terly, because in this case the true amplitude is t
the observed.



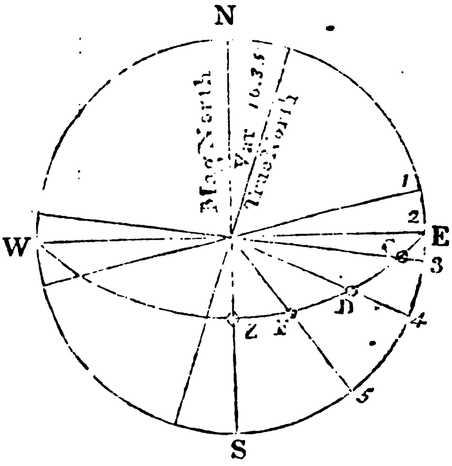
From the true	—	W. 34° 26′ S.
Take the magnetic	—	W. 23 16 S.
Remains the variation		11 13 W.

which is westerly, because the true amplitude is to the left of the observed in this case.

EXAMPLE III.

Suppose the true azimuth 84° 40′ W.

The mag. az.	101	15 W.
* Variation	16	35



* Let N. E. S. and W. represent the horizon; C, D, F, an azimuth circle, passing through the sun's centre; now an observer, placed at the centre, will see the sun at rising, in the line 1, but when he gets a greater altitude, and arrives at E, he will see the sun in the line ☉ 2, and as the sun alters its altitude, will be seen in the lines ☉ 3, ☉ 4, ☉ 5, at length will arrive at its meridian, Z, S, and the figures, 2, 3, 4, 5, will represent the different magnetic azimuths; the difference between any of these and the true azimuth found by calculation, is the variation.

EXAMPLE IV.

Suppose the sun's true amplitude at rising is E. 13° 24′ N. and his magnetic amplitude E. 12° 32′ S. required the variation, and which way.

Since the true amplitude and observed have different names,

To the true amplitude E. 13°	24′ N.
Add the magnetic amp. E. 12	32 S.
Their sum is the variation 25	56 W.

Which is westerly, because the true amplitude is to the left of the observed.

EXAMPLE V.

Suppose the sun's true azimuth in the forenoon is N. 86° 40′ easterly, but by the compass it is N. 73° 24′ easterly; required the variation, and which way.

Since the true and observed azimuths are both on the same side of the meridian,

From the greater	N. 86° 40′ E.
Take the lesser	N. 73 24 E.
Remainder variation	13 16 E.

Which is easterly, because t' true azimuth is to the right o' observed.

EXAMPLE VI.

Suppose the sun's true azimuth is N. 32° 28′ easterly, and his magnetic azimuth N. 8° 50′ west; required the variation, and which way.

Since they are on the different sides of the meridian,

To the true azimuth,	N.	32° 28′	E.
Add the mag. azim.	N.	8 50	W.
Sum is the variation		41 18	E.

Which is easterly, because the true azimuth is to the right of the observed.

EXAMPLE VII.

Suppose the sun's true azimuth S. 17° 45′ E. and the magnetic azimuth S. 5° 48′ W. required the variation, and which way.

Since they are on different sides of the meridian,

To the true azimuth,	S.	17° 45′	E.
Add the observed az.	S.	5 48	W.
Sum is the variation		23 33	W.

Which is west, because the true azimuth is to the left of the observed.

The use of the variation is to correct the course steered by the compass; when the variation is east, it must be allowed to the right hand upon every course steered quite round the compass; but when the variation is west, to the left hand.

NOTE. The variation may be easily found by taking the sun's altitude in the morning, and observing what point of the compass he bears upon; and in the afternoon when the altitude is the same the middle point will be the true meridian, the difference between which at the north or south points of the compass is the variation. If the altitudes are taken at 5, 6, or 7 o'clock in the morning, you will have the same altitude at 5, 6, or 7 o'clock in the evening, being equally distant from noon.

THE METHOD OF KEEPING A SHIP'S RECKONING OR JOURNAL AT SEA.

BY keeping a Ship's Reckoning, or Journal, is meant keeping an account of the ship's way, that the mariner may be able at any time to ascertain the latitude and longitude the ship is in; it therefore should be the great concern of every person who takes upon them the navigating of ships to remote parts, to be expert therein, as the lives and fortunes of so many men are committed to their charge.

When a ship is bound from one place to another, which lies so far from her that she is obliged to go out of sight of land for any considerable time, as from England to Jamaica; at the time of her leaving sight of land, she is said to take her departure, and that part of the land she then leaves is said to be the place she takes her departure from; such as the Land's-end, Lizard, &c. and at the time of taking such departure, the captain or mate generally takes the bearing or distance of that land (according to his judgement,) and sets it down on the log-board, or in the log-book, against the time it was taken, thus, Land's-end, N. N. E. dist. 7 leagues; or Lizard N. by W. dist. 5 leagues, &c.

In the same manner may the departure from any place be taken, as may be seen in the first day's log. of the following journal, where the log-book is marked in columns for hours, knots, fathoms, courses, winds, lee-way, transactions; and under it the columns for courses, distances, northings, or southings, eastings, or westings, the latitude by dead reckoning, latitude by observation, meridian distance, difference of longitude, longitude in, and in the last, bearing and distance of the land.

Notice must be taken, that in the column for course, you are always to set down the course you have made by your reckoning for that twenty-four hours; that is, from the noon of the day before to the noon of the day you work on, the sea account being always kept from noon to noon.

Dead reckoning is that account deduced from occurrences which are written on the log-board.

In the columns for distance you are to set down the distance made by your reckoning for that twenty-four hours.

In the columns of northing and southing, you are to set down the difference of latitude made in that twenty-four hours, marking the column with north, if the difference of latitude be north, and south, if south.

In the column of easting or westing, you are to set down the departure made that twenty-four hours, marking the column with east, if the departure be east, and with west, if westerly.

In the column marked latitude by D. R. you are to set down the latitude you reckon yourself in on that day; and in the column marked lat. by ob. you are to set down the latitude found by obser-

vation ; also the difference of longitude made in the 24 hours in the column marked diff. long. ; the longitude in, in the column marked long. in ; and in the last, the bearing and distance from the land.

The variation, if any, must be allowed upon all courses steered, and upon all bearings that are taken by the compass ; that is, if it be easterly variation, it must be allowed to the right hand ; if westerly, to the left of the course or bearing. Supposing yourself placed in the centre of the compass, and looking directly forward to the point you are to allow the variation upon.

EXAMPLE.

Suppose I steer S. W. and there is one point westerly variation, then my true course is S. W. by S. ; or suppose I set a point of land, and find it to bear by the compass E. S. E. and I know there is half a point easterly variation, then the true bearing is S. E. by E. ½ E.

Leeway must be allowed upon all courses steered, which is the difference between the point which the ship endeavours to sail upon, and the point she really sails upon, and is caused by the force of the wind or surge of the sea, when she is close hauled or plying to windward, which makes her fall off and glide sideways from the point of the compass she capes at, and must be allowed on the right hand of the course steered when the larboard tacks are on board, and to the left hand when the starboard tacks are on board. The allowances that are generally made are as follow:

1st. When a ship is close hauled, if all her sails be set, the water smooth, and a moderate gale of wind, she is then supposed to make little or no leeway.

2dly. The ship being upon a wind, and the small sails in, allow one point for leeway.

3dly. The wind blowing hard, so as to cause one top-sail to be taken in, allow two points for leeway.

4thly. When it blows so hard that both top-sails are taken in, and the sea runs high, allow then three points for leeway.

5thly. The fore-sail being furled, and the ship tries under a main-sail and mizen, allow four points for leeway; for she then makes her way about four points before the beam, as the sea phrase is.

6thly. When the ship tries under the main-sail only, she then makes her way about three points before the beam, that is, allow near five points leeway.

7thly, If the ship tries under the mizen only, the way is about two points before the beam, that is, allow six points for her leeway.

8thly. When she lies hull, that is, with all her sails furled, her way is one point before the beam, and then seven points is her leeway.

9thly. When a ship is lying to under a main-sail, mizen, &c. then observe how she comes up and falls off, and take the middle between the two points, and from that allow the leeway and variation.

NOTE. In all cases respect must be had to the smoothness of the water, or to the sea's running high, and the mould and trim of the ship, and then the allowances may be ascertained with the greater certainty, by setting the ship's wake by a compass placed on each rail of the ship's quarter, which is usually set there for that purpose.

For it is well known that some ships, with the same quantity of sail, and with the same gale, will make more or less leeway than others; and also the same ship, when she is out of her trim, or differently loaded, will make different leeways: for it is observable, that the more water a ship draws, the less leeway she makes; because she then meets with a greater resistance in splitting the water with her side, than otherwise she would.

The leeway may be easily found by the azimuth compass, by turning the instrument about until you see the wake of the ship either over the sights or parallel to them; then the point of the card, which is cut by the vertical line in the box, which is nearest to you, is the true course; the difference between that and the course given by the compass in the binnacle, is the leeway required, which ought to be accordingly entered upon the log-board.

There is another way of finding the leeway, by fixing a compass cut in lead (or other metal) on the poop, or some other convenient part of the ship's stern, with the meridian parallel to the ship's keel.

By some of the above methods, the leeway (if there be any) ought to be carefully observed as often as may be judged necessary; and these observations should be punctually set down by the officer of the respective watch; at least, if no observation be made, he ought to set down the leeway according to his judgement once or twice in the watch, and by this means the course made good may be found to a much greater certainty and exactness than by the common method of allowing for leeway when the day's account comes to be worked (which is generally once in 24 hours); for an observation must certainly be better than any guess. But if no observation be made, the person who is upon deck, and has the care of the watch, is better able to make proper allowances, while things are fresh in his memory, and while he is an eye-witness of the several occurrences that happen; and certainly much more capable than another who was not upon the deck during the whole watch.

I have often admired to see how particularly every thing is stated upon the log-board, excepting the leeway: and yet that (which is one of the most material articles, since the course, according to the compass, must be corrected by it), only allowed for the next day, according to every one's fancy, thereby, as it were, keeping as many different journals as there are artists (so called) on board the ship, and yet not one regular journal properly kept amongst them all, since one of the most material articles is only guessed at.

EXAMPLE I.

Suppose I steer N. E. by E. with my larboard tacks on board, and make one point leeway, then my course made good is E. N. E.

Leeway and variation, when they are both to be allowed one way, that is, both to the right hand, or both to the left, add them together, and allow their sum the same way they were to be allowed.

But if they are to be allowed, one to the right hand and the other to the left, subtract the less from the greater, and allow the remainder the same way the greater was to be allowed?

EXAMPLE II.

Suppose I steer N. N. W. with my starboard tacks on board, and make one point leeway, there being at the time half a point westerly variation; I would know my true course?

Leeway to the left hand	1 Point
Variation to ditto	½ Point
Their sum to be allowed to the left hand	1½ Point

Whence the true course is N. W. by N. ½ W.

EXAMPLE III.

Suppose I steer S. W. by W. with my larboard tacks on board, and make two points and a half leeway, and I have one point and a quarter westerly variation, what is my true course?

Leeway to the right hand	2½ Points.
Variation to the left hand	1¼ Point W.
The remainder to be allowed to the right hand	1¼

Whence the true course W. S. W. ¾ westerly.

EXAMPLE IV.

Suppose a ship lying to under a main-sail, with her starboard tacks on board, comes up E. by S. and falls off to N. E. by E. there being one point westerly variation, and she makes 5 points leeway, what course does she make good?

The middle between E. by S. and N. E. by E. is E. by N. for which allowing 6 points to the left hand, the true course will be N. by E.

It is plain by the preceding examples that if the leeway is made towards the meridian, it is taken from the course steered; but when it is made from the meridian, it must add to the course steered, to find the true course. The same may be observed of the sum or difference of the leeway and variation, as may be seen by the following Table, which is here set down to exercise the young navigator in the foregoing rules.

THE TABLE.

Courses steered.	Winds.	Lee-way.	Variation.	Courses corrected.
N. W. ½ W.	N. N. E.	½	¾ W.	N. 5¾ W.
W.	N. N. W.	¾	¾	S. 6½ W.
W. S. W.	S.	1	¾	S. 6¼ W.
W.	S. S. W.	¾	¾	W.
W. by N.	N. by W.	1¼	¾	S. 7 W.
S. W.	W. N. W.	1½	¾	S. 1 ¾ W.
S.	W. S. W.	¾	1¼	S. S. E.
S. S. W.	W.	1	1¼	S. ¼ E
S. W.	N. W. by W.	½	1¼	S. S. W. ¼ W.
W.	S. S. W.	1¾	1¼	W. by N. ½ W.
W. by N.	N. by W.	1	1¼	W. S. W. ¾ W.
S.	E. S. E.	2	1¼	S. ¾ W.
E. by S.	S. ½ E.	¾	1¼	E. by N.
E. N. E.	N.	1¾	1¼	E. N. E. ½ E.
E.	N.	¾	1¼	E. by N. ½ E.
E.	S.	0	1¼	E. N. E. ¾ E.
S.	E. S. E.	½	1¾	S. by E. ¼ E.
E. S. E.	N. E.	½	1¾	E. by S. ¼ E.
W. S. W.	S.	¾	1¾	S. W. by W.
W. by N.	S. W. by S.	1	1¾	W. ¼ N.
N. W.	W. S. W.	1	1¾	N. W. ¾ W.
S.	W. S. W.	1	0¾ E.	S. ¼ E.
N. by E.	N. W. by W.	¾	1	N. N. E. ¾ E.
N. W. by N.	W. by S.	1¼	1	N. ¾ W.
N. W. by W.	N. by E.	1½	1¼	N. W. by W ¼ W.
W. by S.	N. W. by N.	1¾	2¼	W. ½ S.

Note. In sailing in the channel, or along a coast in a stream-tide or current, particular care must be taken to take its setting for a course, and its drift for a distance, if possible, which must be entered among the courses and distances in the table of that day's reckoning. And where the setting of the stream-tide and drift are not known, you must attain the point it must set upon, from the chart of the coast you are sailing along, by the times the stream ends at different places on the coast, and by the principles of fluids against such rocks, shoals, sand-banks, &c. By a strict regard to these, both the drift and setting of the stream-tides may be pretty nearly ascertained and allowed for.

Currents, the way they set you, and the distance you suppose you are driven by them, is to be set in the Traverse Table for the day, as any other course and distance.

EXAMPLE V.

Suppose I try the current, and find it to set W. by N. per compass one mile per hour, the variation being one point easterly; then if I sail in that current 24 hours, I set down in the Traverse Table, as a course, W. N. W. distance 24 miles.

he sea is to be accounted for in the same manner as cur-
ppose there is a great sea heaving towards the S. W. by my
e being half a point westerly variation, I then set down in
Table S. W. by S. half westerly, with so much distance as I
as heaved the ship.
the land, the opposite point of the bearing, with the vari-
upon it, and the distance you judge yourself from it, must
n the Traverse Table as a course and distance.

EXAMPLE VI.

aving two points and a half westerly variation, the Start
y compass N. E. dist. 4 leagues; the opposite point to N. E.
h, with the variation, makes S. by W. ½ W. for the cou. to
Traverse Table dist. 12 miles.
make the land the bearing, itself (with the variation
it) and the dist. you judge yourself from it) is to be set
Traverse Table as a cou. and dist. This needs no exam-

s marked on the log-board are the courses steered by the
order to obtain the true course, it is necessary to allow
variation of the compass, and for the leeway, upon each
log-board, as has been shown, before they are put into the
le.
at noon the log-board is to be transcribed into the log-
s ruled exactly like the log-board.
keep the reckoning for the ship's place. From noon to
mark with P. M. signifying after mid-day; and the second
with A. M. signifying after midnight; ending their day's

RULES FOR CORRECTING THE DEAD RECKONING BY AN OBSERVATION.

NOTWITHSTANDING the rules already laid down for keeping a ship's way at sea, yet by reason of the several accidents that may attend a ship in one day's run, such as swelling seas, different rates of sailing between the times of heaving the Log, want of care at the helm in letting the ship fall off, or come to, accidental currents, sudden squalls, when no account can be kept, &c. the latitude by account and latitude by observation may very often differ, then it is necessary that proper corrections be made in the difference of longitude.

When you have made all proper allowances you can, such as for leeway, variation, currents, &c. and still find that your latitude by account will not agree with your latitude by observation, then you must correct as follows:

First, consider whether you have made proper allowances for currents, heave of the sea, if the course of the helm has been carefully attended to, if the log-line and half-minute glass be just, and the log properly hove, or any sudden squalls, or proper allowances made for the leeway, &c. which of these you conjecture your error is in; make what allowances you think meet to your difference of latitude and departure by dead reckoning, and see if that will reform your latitude by account, so as to make it agree with your latitude by observation; if it does, you have guessed right (for you must always keep to the latitude by observation, it being the only thing to be depended on); but if it will not agree with the observed latitude, it is to be supposed that there are mistakes in your conjecture, or some other cause, which produces the error in the reckoning, and stands in need of being corrected. In this case, you are first to examine your log-line and half-minute glass, and if there be an error in them, allow for it, as in the following Examples:

EXAMPLE I.

Yesterday at noon, we were in latitude 48° 20′ N. and till this day at noon we have sailed S. S. W. 48 miles, S. W. by S. 36 miles, N. E. 24 miles, and find by good observation that we are in latitude 47° 14′.

TRAVERSE TABLE.

COURSES.	DIST.	N.	S.	E.	W.
S. S. W.	48		44.3		18.4
S. W. by S.	36		29.9		20.0
N. E.	24	17.0		17.0	
		17.0	74.2		38.4
			17.0		17.0
			57.2		21.4

verse Table it appears, that by account the diff. of lat. is
e departure 21.4 W.

eft was —	48° 20′ N.	Lat. left 48° 20′ N.
. by account	0 57 S.	Lat. obs. 47 14 N.
ount	47 23 N.	Diff. Lat. 1 6=66

les from the true latitude by observation.

I examine the log-line and half-minute glass, and find that easures 52 feet between knot and knot, and that the latter seconds. Now, as the log-line and half-minute glass are correct my difference of latitude and departure, as in Case my correct difference of latitude 66.2 S. and my departure

from latitude left —	48° 20′ N.
e diff. lat. corrected for error in dist.	1 6 S.
in, corrected for error in dist.	47 14

ctly with my latitude by observation : I therefore conclude sufficiently correct. Then, with the difference of latitude, parture 24.7, together with yesterday's latitude, I find the ongitude either by Middle Latitude, or Mercator's Sailing.
example 57.2 and 21.4 multiplied severally by 156, thrice length of a knot, and divide the two products by 135, five sured time of the glass, will give the difference of latitude parture 24.7, which is the same thing as if every course had l separately.

Latitude sailed from	36° 15′ N.		36° 15′ N.
Difference of latitude by account	1 4 S.	Lat. obs.	34 56
Latitude in by account	35 11 N.	Diff. lat.	1 19

Differing 15 miles from the latitude by observation.

I now examine the log-line and half-minute-glass, and find them both right. Next I consider whether there be any current, and I think I have reason to suspect one; upon trial I find there is one setting S. S. W. ¾ W. at the rate of 7 fathoms an hour, and judge I have been in it these 24 hours. Then 7 fathoms (or tenths of a knot) per hour, in 24 hours, makes about 17 miles: and to the dist. 17 miles, and course S. S. W. ¾ W. the diff. of lat. is 14.6 S. and departure 8.7 W.

	Diff. lat.	Dep.		
Now by tra. table	64.2 S.	16.9 W.	Latitude sailed from	36° 15′ N.
And by current	14.6 S.	8.7 W.	Diff. of lat. cor. for cur.	1 19 S.
Correct for cur.	78.8 S.	25.6 W.	Lat. in, correct for cur.	34 56 N.

Which agreeing with my latitude by observation, I conclude that my reckoning is right; then having the latitude left, and latitude come to, the difference of longitude may be found either by Middle Latitude or Mercator's Sailing, as before.

If, after all proper allowances are made for errors in distance, currents, &c., the latitude by account and observed latitude should disagree, then the reckoning must yet be further corrected; and to do which, the following are the common, and seem to be the most rational, methods:—

CASE I.

If the Course found by Dead Reckoning be less than three Points, or thirty-three Degrees.

RULE. To the difference of latitude and departure by account find a course; with this course and the difference of latitude by observation, find the difference of longitude, either by Middle Latitude, or Mercator's Sailing.

EXAMPLE.

Yesterday at noon we were in lat. 39° 18′ N. by an observation; this noon we are in lat. 37° 48′ N. and our dead reckoning gives 107 miles of southing, and 64 of westing; required the true difference of longitude?

To the difference of latitude 107, and departure 64, I find the course 2¾ points; then with the meridional difference of latitude between the two observations 115, and the same course, I find the true difference of longitude 69 miles.

CASE II.

If the Course found by Dead Reckoning be more than three Points, or thirty-three Degrees, and less than five Points, or fifty-six Degrees.

Rule. With the diff. of lat. and dep. by account, find the distance; with this distance, and diff. of lat. by observation, find another departure. Take half the sum of this dep. and dep. by account, for the true dep. with which, and the diff. of lat. by observation, find the diff. of longitude.

EXAMPLE.

Yesterday at noon we were in lat. 52° 40′ N. and are this noon in lat. 54° 22′ N. having by account made 84 miles of northing, and 76 miles of westing; required the true difference of longitude?

To the diff. of lat. 84, and dep. 76, the distance is 113 miles, and the course 42°.

To dist. 113, and diff. of lat. between the two observations 102, the dep. is 49.5; then 76 added to 49.5 is 125.5, half of which is 62.7, the true dep.

To dep. 62.7, and diff. of lat. by observation 102, the course is 31°, and with the course 31° and the meridional diff. of lat. between the two observations 171, I find the diff. of long. is 103 miles.

CASE III.

If the Course by Dead Reckoning be more than five Points, or fifty-six Degrees.

Rule. With the diff. of lat. and departure by account find the distance; then with this dist. and diff. of lat. by observation find the diff. of long.

EXAMPLE.

Yesterday at noon we were in lat. 38° 52′ N., to-day at noon we are in lat. 40° 18′ N., and by account have made 68 miles northing, and 112 miles of westing; required the true diff. of longitude?

With the diff. of latitude 68, and departure 112, I find the distance 131 miles, and to distance 131, and difference of latitude by observation 86, the course is 49°, nearly; with this course, and the meridional difference of latitude between the two observations 111, the difference of longitude is 128 miles.

The reason of the above rule is plain, if we consider, that when a ship sails near the meridian, it will require a sensible error in the course, to make any considerable error in the difference of latitude; which can hardly happen if proper care is taken at the helm, and therefore it is most likely that the error is in the distance run; *but when* the course is near the middle of the quadrant, or between *3 and 5 points* from the meridian, it is then probable the error may

be in both course and distance; and when the course is more than five points from the meridian, it is then most likely the error is in the course, as it will require a great error in the distance to make any considerable one in the difference of latitude.

NOTE. As the true place of a ship depends upon her latitude and longitude being truly ascertained, I have set these down only, the rest being of less consequence to the mariner.

To correct for several Days.

By help of the three preceding rules, the longitude may always be corrected for a single day; but if an observation has been wanted for one or more days, then mark the latitude and longitude at last observation, or if this be your first observation since leaving the land, mark the latitude and longitude of the land you left; this is the only latitude and longitude you can call certain; all the following part of the reckoning must undergo a correction, which is made as follows;

Take the northings, southings, eastings, and westings, that you have made since your last observation; or, if this be your first observation, then for every day from your leaving the land, minding not to leave out the difference of latitude and departure of the day you correct on, and bring them into the Traverse Table, by which you will have the whole difference of latitude and departure by account since the last observation; and with that same difference of latitude and departure find the course by dead reckoning; then observe which of the foregoing cases that course falls under, and correct by the rule for that case. But when an observation has been wanting for several days, then mark the latitude and longitude you were in at your last observation, or on leaving the land as before, and then you may correct with a greater degree of certainty, especially in high latitudes, by the following rules;

CASE I.

Reckoning from the last certain latitude and longitude.

When the course given by the meridional difference of latitude and difference of longitude by account, taken as difference of latitude and departure, is less than three points, or 33 degrees.

RULE. To the meridian difference of latitude and difference of longitude by account (taken as difference of latitude and departure, as shown in Mercator's Sailing), find a course; with this course, and the meridian difference of latitude by observation, find a corresponding departure, which will be the correct difference of longitude.

EXAMPLE I.

Having sailed three days ago from latitude 49° 57′ N., and got no observation till this day at noon, and find I am in latitude 45° 23′ N., and by dead reckoning I am in 45° 12′ N. having differed my longitude 183 miles; required my difference of longitude?

		M. Parts.			M. Parts.
Lat. sailed from	49° 57′ N.	3470	Lat. sailed from	49° 57′	3470
Lat. by account	45 12 N.	3047	Lat. by obser.	45 23	3063
Diff. of lat.	4 45		Diff. of lat.	4 34	
Merid. diff. of lat. by acc.		423	Mer. diff. of lat. by obs.		407

To meridian difference of latitude by account 423, and difference of longitude by account 183, the course is 23° 24′. Then with the course 23° 24′, and meridional difference of latitude between the observations 407, I find the difference of longitude is 176 miles.

CASE II.

When the course given by the meridional difference of latitude and difference of longitude by account (taken as before) is greater than three points, and less than five points.

RULE. To the meridian difference of latitude and difference of longitude by account, taken as difference of latitude and departure, find a distance; with this distance, and meridian difference of latitude by observation, find a corresponding departure; half the sum of this departure, and the difference of longitude by account, is the correct difference of the longitude.

EXAMPLE II.

Three days ago we were in latitude 45° 23′ N. and have since that time sailed between south and west, have by dead reckoning altered our latitude 94 miles, and our longitude 147 miles; but by an observation this day, we find we are in latitude 43° 34′; required the correct difference of longitude?

		M. Parts.			M. Parts.
Lat. sailed from	45° 23′ N.	3063	Lat. sailed from	45° 23′ N.	3063
Lat. by acc.	43 49 N.	2931	Lat. by obser.	43 34 N.	2910
Diff. of lat.	1 34		Diff. of lat.	1 49	
Mer. diff. of lat. by account		132	Mer. diff. of lat. by observation		153

With the meridian difference of latitude by acc. 132, and difference of longitude by acc. 147, I find the distance 198, and course 48°. Then with the distance 198, and meridian difference of latitude by observation 153, the dep. is 125; now 125 added to 147 is 272, and half this sum, viz. 136, is the correct diff. of longitude.

CASE III.

When the course given by the meridian difference of latitude and difference of longitude by account (taken as before) is more than five points, or 56 degrees.

RULE. To the meridian difference of latitude and difference of longitude by account, taken as difference of latitude and departure, find a distance.

To this distance and meridian difference of latitude by observation, find a corresponding departure, this departure will be the correct difference of longitude.

EXAMPLE III.

Two days ago I was in latitude 43° 34′ N., and have since then made by account 50 miles by southing, and 256 miles difference of longitude west, but find by observation that I am in 42° 30′ N.; what is my true difference of longitude?

		M. Parts.			M. Parts.
Lat. sailed from	43° 34′ N.	2910	Lat. sailed from	43° 34′	9 0
Lat. by account	42 44 N.	2841	Lat. by obser.	42 30	2822
Diff. of lat.	50		Diff. of lat.	1 04	
Mer. diff. of lat. by account		69	Mer. diff. of lat. by obser.		88

Then to meridian difference of latitude by account 69, and diff. of longitude by account 256 (taken as difference of latitude and departure), the distance is 265, and course 75 degrees.

And to distance 265, and difference of latitude 88 (the meridian difference of latitude by observation), the departure is 250, which is the correct difference of longitude.

Here we have given, at some length, the different methods of correcting the dead reckoning by an observation, which are readily done by the Table of Difference of Latitude and Departure.

The ship's way is generally greater than the distance given by the log, and it is always safest to have the reckoning ahead of the ship, that the mariner may be looking out for land, and not make it before he is aware of it.

When a great sea sets after the ship, it is common to allow one mile over for every ten given by the log, for the heave of the sea; but if the sea be athwart or against her, her distance must be less than that given by the log.

The error in the ship's reckoning is frequently attributed to unknown currents; for by various causes, yet undetermined, there are many counter-motions of the water in the open seas, as well as those observed near the shores, where the motions may be tolerably well accounted for. Some of the observed currents in the great seas may perhaps be owing to the tides following the moon, and to the libratory motion the waters may have thereby, and the unsettled setting and drift of these currents may possibly depend on the change in the moon's declination. However, it is well known from observations, that the trade-winds occasion a considerable current within their limits, particularly within the torrid zone, where the motion is perpetually towards the west, at the rate of eight or ten miles a day, but at the extremities of the trade-winds, or near the latitudes of 30° N. or S. it is likely that the currents are compounded of the said western motion, and of one towards the equator; therefore all ships sailing within these limits should allow a course each day for this current.

and then proceed to a continued Journal from Lo
and Teneriffe, in which will be inserted most of
that commonly happen at sea or in harbour.

I have seen many young navigators, who have
principles of navigation on shore very deficient ir
nal at sea; and therefore must request the teache
ting the pupils over the following Journal, which
ready at working a day's work at sea, and confirm
those rules they have been over.

EXAMPLE I.

Yesterday at noon we were in the latitude of 46° 28′ N. and long. 22° 18′ W. and have sailed till this day noon, as by the log-board, the current having all time set S. by E. 2½ miles per hour; required the ship's place and the direct course and distance made good?

LOG-BOARD.

H.	K	F.	Courses.	Winds.	L. Way
1	6	3	N. N. E.	W.	
2	6	2			
3	6	5			
4	6	4			
5	6	0			
6	6	1	E. N. E.	N. W.	
7	6	6			
8	5	8			
9	5	6			
10	5	4			
11	5	5			
12	5	3	E. by S.	N.	
1	5	9			
2	6	2			
3	6	0			
4	6	3			
5	6	4			
6	7	0	S. S. E.		
7	6	8			
8	7	3			
9	7	5			
10	7	1			
11	7	9			
12	7	3			

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
N. N. E.	31	28 6		11.9	
E. N. E.	35	13.4		32.3	
E. by S.	36		7.0	35.3	
S. S. E.	51		47.1	19.5	
S. by E.	60		58.8	11.7	
		42.0	112.9	110.7	Dep.
			42.0		
		Diff. Lat.	70.9		

Lat. left 46° 28′ N. M. P. = 3156
Diff. lat. 1° 11′ S.

Lat. in 45 17 N. M. Par. = 3054

Sum lat. 2)91 45 Mer. D. Lat. = 102

Mid. lat. 45 52
Co. M. lat. 44 08

Long. left 22 18 W.
Diff. of lon. 2 39 E. or 2° 40′

Long. in 19 39 W.

Direct Cou. S. 57° 22′ E. Dist. 131m.

The courses and winds on the log-board being examined, it appears that the ship sails large and has no lee-way; therefore the several courses from the log-board are entered into the Traverse Table without alteration.

Next the fathoms and knots belonging to each course are summed up, and the results are put in the column of distances in the Traverse Table; and to these courses and distances, the whole difference of latitude, departure, course, and distance made good, are found as above.

Then, having the latitude left, and the latitude come to, find the complement of the middle latitude, and with that and the departure find the longitude, &c. by middle latitude sailing.

Or, with the course, and meridional difference of latitude, find the difference of longitude by Mercator's Sailing.

NOTE. When the odd fathoms are above five, we allow one knot, but if under five, nothing is allowed.

EXAMPLE II.

being yesterday noon in latitude 25° 30′ S. and longitude
have sailed till this day noon, as per log-board, in a cur-
uth 2½ miles an hour, the variation 1½ point west; requir-
place?

og-Board.			Traverse Table.					
s.	Winds.	L.Way	Courses.	Di[illegible]	N.	S.	E.	W.
.	W.N.W.	1	S.by W.½W.	30		28.7		8.7
			S.by E. ½ E.	32		30.6	9.3	
			S. ½ E.	30		29.9	2.9	
			S.E.by E.½E	39		18.4	34.4	
			S.by E.½E.	60		57.4	17.4	
V.	W. by S.	1		Diff.Lat.		165.0	64.0	8.7
							8.7	
							55.3	Dep.
			Diff. lat.	2° 45′ S.				
V.	W.	1	Lat. left	25 30 S.		Mer. parts		1583
			Lat. in	28 15 S.		Mer. parts		1768
			Sum lat.	53 45		M. diff. lat.		185

EXAMPLE III.

Yesterday at noon we were in latitude 33° 40′ N. longitude 16° 18′ west, the sun was observed to set 50° 18′ from the north point of the compass; we have sailed this day noon, as per log-board, in a current setting W. S. W $1\frac{1}{2}$ mile per hour; required the ship's place, and her course and distance to the west end of the island of Madeira.

Log-Board.

H.	K.	F.	Courses.	Winds.	L. Way
1	6	2	S. by W.	W.	0
2	6	0			
3	6	3			
4	7	0			
5	7	2			
6	7	3			
7	7	2	S.W.by.S.	W. by N.	1
8	7	2			
9	7	4			
10	7	6			
11	7	4			
12	8	1			
1	8	0			
2	8	5			
3	8	2			
4	7	5	S.W.by W.	N. W.	0
5	7	3			
6	6	6			
7	6	4			
8	6	0			
9	6	2			
10	6	1			
11	6	3			
12	6	1			

Traverse Table.

Courses.	Dist.	N.	S.	E.	W
S. 01° E.	40		40.0	0.7	
S. 10 W.	70		68.9		12.2
S. 44 W.	58		41.7		40.3
S. 55 W.	36		20.6		29.5
	Diff.	lat.	171.2	0.7	82.0
					0.7
				Dep.	81.3

Before the courses can be corrected to put into the Traverse Table, the variation of the compass must be found from the sun's true amplitude.

The declination is 22° 30′ N.

As cos. lat. 33° 40′ : rad. :: sin. 22° 30′ : sine 27° 22′. Comp. = 62° 38′

So that the true amplitude = N. 62° 38′W.

Mag. amplitude = N. 50 18W.

Variation = 12 20W

The courses on the log-board being corrected by this variation and the lee-way, will give the courses fitted for the Traverse Table.

Lat. left	—	33° 40′ N.
Diff. lat.	—	2 51 S.
Lat. in		30 49 N.
Sum lat.	—	64 29
Mid. lat.	—	32 14
Co. mid. lat.	—	57 46 N.
Long. left	—	16 18 W.
Diff. long.	—	1 38 W.
Long. in	—	17 56 W.

Madeira's lat.	32° 38′N.	M. parts	2073
Lat. in	30 49 N.	M. P.	1945
Diff. lat.	1 49 = 109 miles		128
Sum lats.	63 19		
Mid. lat.	31 39		
Co. mid. lat.	58 21		
Madeira's long.	17 5W.		
Long. in	17 56W.		
Diff. long.	0 51E.		

The course N. 21 44 E. dist. 117 miles.

In the work for the amplitude, the latitude at sun-set was taken the same as at noon; for although there were about 46 miles of southing in that time, and so the latitude at sun-set was about 34° 52′, yet the amplitude being only 15′ less, the alteration in variation would scarcely affect the difference of latitude and departure found from the courses so corrected.

EXAMPLE IV.

Yesterday at noon we were in latitude 19° 30′ S. and longitude 0° 10′ E. This forenoon we observed the sun's altitude to be 10° 40′ when he was 80° 30′ from the north point of the compass, declination being then 17° 27′ N. We have sailed till this day noon, as per log-board, in a current setting by the compass W. N. W. ½ mile an hour. Required the ship's place, and her direct course and distance to the island of St. Helena.

Log-Board.

H	K	F	Courses.	Winds.	Lee-way.
1	6	7	N. by E.	E. by N.	1
2	6	2			
3	6	4			
4	6	3			
5	6	1			
6	6	0			
7	5	8	North.	E. N. E.	1
8	5	4			
9	5	0			
10	5	3			
11	5	6			
12	5	9			
1	5	7			
2	6	4	N. N. W.	N. E.	1
3	6	8			
4	7	0			
5	7	3			
6	7	6			
7	7	5			
8	7	0			
9	7	2			
10	7	4			
11	6	3			
12	6	0			

Traverse Table.

Courses.	Dist.	N.	S.	E	W.
N. 13° W.	38	37.0			8.5
N. 25 W.	39	35.3			16.5
N. 47 W.	76	51.8			55.6
N. 81 W.	12	1.9			11.9
		126.0	Diff. Lat.	Dep.	92.5

Diff. lat. 2° 6′ N. M. Parts.
Lat. left 19 30 S. 1193
Lat. in 17 24 S. 1060
Sum lat. 2)36 54 Mer. dif. L. 133
Mid. lat. 18 27
90 00
Co. mid. lat. 71 33
Longitude left 00° 10′ E.
Diff. long. 1 37 W.
Present long. 1 27 W.

Lat. 19° 30′ S. Alt. 10° 40′ Dec. 17° 27′ N.
90 0 90 0 90 0
Co. alt. 79 20 P. Dist. 107 27
Co. lat. 70 30 Co. sec. 0.02565
Co. alt. 79 20 Co. sec. 0.00757
P. dist. 107 27
Sum 2)257 17
½ Sum 128 38 Log. sine 9.89274
P. Dist. 107 27
Rem. 21 11 Log. sine 9.55793
2)19.48389
Co. s. true azimuth. = 56° 30′ — 9.74194
2
True azimuth 113 0 from the S.
180 0
True ditto 67 0 from the N.
Mag. azimuth 80 30 from the N.
Variation 13 30 W.
Lat. in 17° 24′ S. M.P. 1060 Long. in 1° 27′ W.
St. Hel. L. 15 55 S. M.P. 968 St. Hel. lo. 5 43 W.
Diff. lat. 1 29 M.D. Lat. 92 Diff. long. 4 16
60 60
In miles 89 In miles 256

With the meridional difference of latitude and difference of longitude, the direct course to St. Helena is found S. 70° 14′ W. and with that course and the proper difference of latitude the distance is found 263 miles.

A JOURNAL

OF

A VOYAGE FROM LONDON TO MADEIRA,

AND

TENERIFFE,

IN THE ENDEAVOUR, OF LONDON;

WILLIAM CLEAR, COMMANDER;

KEPT BY JOSEPH BRIGHT, MATE.

Departure taken from the Lizard in latitude 49° 57′ N. longitude 5° 12′ W. bound for Funchal, in Madeira, in latitude 32° 38′ N. longitude 17° 5′ W. and to Santa Cruz, in Teneriffe, in latitude 28° 28′ N. longitude 16° 16′ W. bearing from the Lizard-Point S. 27° 28′ W. distance 1166 Miles.

Begun April 25, 1810.

In the following JOURNAL is exemplified, the manner of allowing of the variation, lee-way, lying-to, calms, currents, heave of the sea, &c. and to correct the dead reckoning, by an observation, in all cases; with most of the occurrences that commonly happen at sea, and the ship's way pricked off on MERCATOR'S CHART.

day 5,	At 5 A. M. the pilot came on board; then weighed and sailed from Tower Wharf: at 11 came to with the best bower at Blackwall. Wind S.S.W.
ay	Fresh gales and cloudy weather, with rain. At 5 A. M. weighed and sailed, at 9 came to an anchor at Gravesend, and cleared ship. Wind from S. S. W. to N. N. W.
y	At 4 P. M. weighed and sailed, moderate weather; at 9 came to with the best bower at the Nore in 9½ fathoms, fresh gales; at 4 A. M. weighed and sailed: at 11 came to anchor in the Downs in 7 fathoms, Deal Castle bearing W. ½ S. distant 3 miles. Wind W. by S.
y	At 1 P. M. set the pilot on shore. These 24 hours, the first and middle parts moderate and fair, the latter part strong gales and cloudy; hoisted the boats in.
y	Strong gales and cloudy; at 2 P. M. veered out the long service of the best bower, got top-gallant yards and mast down; at 4 P. M. struck yards and top-mast. These 24 hours had very

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Friday, May 4, 1810.
2			S. by W. ¼ W.	N. ½ W.		At 2 P. M. hove short.
4						At 4 weighed and sailed in Co. with a 40 gun man of war, and 20 sail of merchantmen.
6						
8						
10			W.	N. by W.		At 6 S. Foreland bore N. N. W. dist. 4 M.
12			S.W. by W. ¼ W.			At 2 A.M. Fairlee bore N. dist. 6 M.
2						At 6 Beachy bore N. by W. 6 miles.
4			W. N.W. ¼ W.	N. ½ W.		At 8 Beachy bore N. E. by E. 9 miles.
6			W. S. W.	N. by E.		Fresh gales and clear, several ships standing up Channel; close reefed both topsails.
8						
10						At 12 Bembridge P. bore W. N. W. 27 M. still in company with the fleet.
12						

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Saturday May 5.
2			W. ¼ S.	N. E.		
4	4	6				Fresh gales and clear.
6	5	5				At 4 P. M. parted with the fleet, they being bound to Spithead. Dunnose bearing W. N. W. distant 21 miles.
8	5	0				
10	5	1				
12	4	6				At 5 let out one reef of each top-sail.
2	5	0				At 7 A. M. Portland light bore W. N. W. 9 miles.
4	4	4				
6	4	5				At 10 A. M. it bore N. E. 12 miles, 14 sail in sight.
8	4	0				
10	4	2	W. by S. ½ W.	N. N. E.		Out reef topsails.
12	5	0				

Being upon the coast this last day, the log is hove, and the bearings and distances of lands, rocks, sands, &c. as you approach them, must always be set down, and are of the greatest consequence, especially in bad weather, or when you are in danger of being drove out of your true course, in the night, or in a fog; so that you may at any time determine, by your reckoning, or the chart, the ship's place, and to sail courses and distances as circumstances require, in order to pass places of danger, and to have it always in your power to take your departure from some known place, in case you should be drove out to sea in the night or in foggy weather, when no land can be seen. For it sometimes happens, that in working to windward in the English Channel, E. of Dunnose, ships, by making too long a board, have got upon a sand called the Owers, on which there is now a floating light. It is therefore absolutely necessary to have good draughts of the coasts you sail upon, unless you are well acquainted with them indeed.

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Sunday, May 6, 1810.
2						These 24 hours moderate gales and fair weather.
4						
6						Set top gallant sails.
8	4		W. S. W.	N. E.		At 6 P. M. the Lizard bore N. N. E. distance 6 leagues, from which I take my depar. it being in the lat. of 49° 57′ N. and long. 5° 12′ West of London.
10	4	5				
12	5					
2	5					
4	5	5	S. W. by W.			Several sail in sight standing to westward.
6	5	5				At noon, Ushant N. 82° 21′ E. distance 54 miles. In top gallant sails.
8	5	5				
10	5	5				Variation 2½ points westerly.
12	6					

Course.	Diff.	S.	W.	Lat. by D. R.	Lat. by Obs.	Diff. lon.	Long. in.	Bearing and Dist.
S. 26° 38′ W.	107	96	48	48 21 N.		1° 14′ W	6°26′ W.	Funch. S. 27 4′ W. D. 1059 M.

The Lizard bearing N. N. E. dist. 6 leagues from the ship, is the same as if the ship had sailed from the Lizard 6 leagues or 18 miles upon the opposite or S. S. W. point of the compass, and allowing for the variation, as before taught, makes it S. half E. dist. 18 M. which is to be set down as the first course and distance in the following Traverse Table.

The first course steered by compass is W. S. W. which, allowing for the variation, make S. W. by S. half W. and the sum of all the distances sailed on that course till two o'clock, when it alters, is 18 miles and a half, which being doubled, because the log is heaved every two hours, gives 37 miles; so the second course and dist. to be set down in the Traverse Table is S. W. by S. half W. 37 miles. In like manner the second course steered is S. W. by W. and the variation allowed makes it S. S. W. half W. and the dist. on that course summed up and doubled, gives 56 miles; therefore the third course and dist. to be set down in the Traverse Table is S. S. W. half W. 56 miles. Having found the whole difference of latitude and departure made upon the several courses, I then mark down upon my slate or paper what every thing that is to be found comes to, and afterwards set them down in their proper columns as under.

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S. ½ E.	18		17.9	1.8	
S.W. by S½W.	37		28.6		23 5
S. S. W. ½ W.	56		49.4		26 4
		Dif. Lat.	95.9	1.8	49 9
					1 8
				Dep.	48 1

Now to diff. of lat. 95. 9 S, and dep. 48.1 W. the course is S. 26° 38′ W. dist. 107 miles: then

Lat. sailed from, or Lizard's lat.		49° 57′ N.
Diff. of lat. 95 9	=	1 36 S.
Lat. in, or ship's lat.	—	48 21 N.
Sum of lat.	—	98 18
Middle lat.	— —	49 9
Com. of middle lat.	—	40 51

Then with this com. of mid. lat. 40° 51′ or 40° found as a course among the degrees, and the dep. 48, 1 in its column, in the dist. col. stands 74, which is the diff. of long.

Or, with the course 26 38 and meridional diff. of lat. 147, the diff. of long. is found to be nearly 74 by Mercator's Sailing.

Longitude sailed from, or Lizard's longitude	5° 12′ W.
Difference of longitude 74 miles	1 14 W.
Longitude in, or ship's longitude	6 26 W.

To find the Bearing and Distance of Ushant.

Latitude in	48° 21′ N.	Mer. parts	3323	Longitude in	6° 26′ W.
Ushant's lat.	48 28	Mer. parts	3334	Ushant's long.	5 4 W.
Difference of lat.	7	Mer. Diff. of Lat.	11	Diff. of Long.	1 22

With the mer. diff. lat. and diff. long. Ushant is found to bear N. 82 22 E. and with that bearing, taken as a course, and the proper difference of latitude, the distance is found 53 miles.—The bearing and distance to Funchal is found in the same manner.

H.	K.	F.	Courses.	Winds.	Lee-Way.	REMARKS on board, Monday, May 7, 1810.
2	6		SWbyW$\frac{1}{2}$W.	N.		These 24 hours moderate gales, and cloudy
4	5	5				weather.
6	5			N. W.		At 4 P. M. spoke the Charming Nancy, from
8	5					South Carolina, bound to London. At 8
10	3	6	S. W. $\frac{3}{4}$ W.			set top-gallant sails.
12	3	4				
2	3	4				At 6 A. M. got the bower anchors on the
4	4	5				gunnel, and unbent the cables and stowed
6	4	6				them.
8	5		S.W.byS$\frac{1}{2}$W	W. N. W.		At noon C. Ortegal bore S. 1° 20′ E. dist.
10	4	5				181 miles.
12	4					Variation $2\frac{1}{2}$ points westerly.

Course.	Dist.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Diff. long.	Long. in	Bearings and Distance.
		S	W.	N.		W.	W.	Funchal S. 27°20′W.
S.30°W	108	93	53	46 48		1 19′	7° 45′	Distance 957 miles.

The variation being allowed on each course, and the distances summed up, as before taught, the Traverse Table will stand thus:

With the difference of latitude and departure the course is found S. 30° 0′ W. and the distance 108 miles.

Diff. of latitude	1° 33′ S.	Mer. parts.	
Latitude left	48 21 N.		3328
Latitude in	46 48 N.		3185
Sum lat.	95 9	Mer. diff. lat.	138
Middle latitude	47 34		
	90 0		
Com. mid. lat.	42 26		

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S.W.byS.$\frac{1}{4}$W	43		33.2		27.3
S.S.W.$\frac{1}{4}$W	39		34.4		18.4
S.byW.$\frac{1}{2}$W.	27		25.9		7.8
		Diff. Lat.	93.5	Dep.	53.5

The diff. of long. is found by Mercator's, or Middle Latitude Sailing, to be 1° 19′ W.
Yesterday's longitude 6 26 W.

Longitude in — 7 45 W.

To find the Bearing and Distance of Cape Ortegal.

Latitude in	46° 48′ N.	Mer. parts	3185	Longitude in	7° 45′ W.
Cape's latitude	43 47 N.	Mer. parts	2928	Cape's long.	7 51 W.
Difference of lat.	3° 1	Mer. dif. lat.	257	Dif. long.	6
In miles	181				

With the merid. diff. of lat. and diff. of long. the direct course to Cape Ortegal is S. 1° 20′ E. and with that course, and the proper difference of latitude, the distance is 181 miles.

NOTE. As the Table of Difference of Latitude and Departure is only calculated to single degrees, the nearest degree to the com. of middle latitude is to be taken in working by inspection to find the difference of longitude by: thus the com. of mid. latitude is 42° 26′, for which I take 42° to find the difference of longitude. The same may be observed in finding the course made good, the nearest degree or $\frac{1}{4}$ degree to the course is always set down, and will be found sufficiently exact.

Courses.	Winds.	Lee-way.	REMARKS on board, Tuesday, May 8, 1810.
W.S.W. ¾ S.	N. W.	0	These 24 hours moderate gales and clear weather. At 6 P.M. saw a ship to the westward. 90 Observed sun's mer. alt. at noon 61 35
S. W. by S.	W. by N.	½	Zenith distance - - 28 25 S. Declination - - - 16 58 N.
S. S. W.	West.	1	Latitude - - - 45 23 N. At noon C. Ortegal S. 7° 0′ E. dist. 97 M. Variation 1½ point westerly.

Dif. Lat.	Dep.	Lat. by D. R	Lat. by Obs.	Dif. of Long.	Long. in.	Bearing and Dist.
S.	W.	N.	N.	W.	W.	Funchal S. 28 29′ W.
96	22	45 12.	45 23	0. 30	8. 8	Dist. 870 miles.

By allowing for variation and lee-way the work will be as follows:

. of lat. and dep. the course is
. and the dist. 97 miles.

1°	36′ S.		Mer. parts.
46	48 N.		3185
. 45	12		3047
		Mer. diff. lat.	138
2)92	0		
46	0		
90	0		
44	0		

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S. W. ¼ S.	28		20.7		18.8
S. by W.	36		35.3		7.0
S. ½ E.	40		39.8	3.9	
	Dif. lat.		95.8	3.9	25.8
					3.9
				Dep.	21.9

Longitude left 7° 45′ W.

H	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Wednesday, May 9, 1810.
2	3	5	S. by W. ¾ W.	West.	1	These 24 hours moderate gales and clear weather.
4	3	5				
6	3	5				
8	2					
10	3	5				At 8 P. M. set up the mizen top-mast shrouds, and back-stays.
12	2					
2	3					At noon Cape Ortegal South, distance 21 miles.
4	2					
6	3		S. by W.	W. by S.	1	Variation 1¾ point westerly, per amp.
8	4					Handed top-gallant sails.
10	4					Thick hazy weather.
12	4					Down top-gallant yards.

Course.	Dist.	Dif. lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Dif. of Long.	Long. in.	Bearing and Dist.
S. 9° E.	76	75 S.	12 E.	N. 44° 8′		17 E.	7° 51′ W.	Funchal S. 31° 15′ W. dist. 844 miles.

With the diff. of lat. and dep. the course is found S. 9° E. and the dist. 76 miles.

Dif. of lat.	1°	15′ S.	Mer.	parts.
Yesterday's lat.	45	23 N.		3063
Lat. in	44	8 N.		2957
Sum lats.	2)89	31	Mer. diff. lat.	106
Mid. lat.	44	45		
	90	0		
Com. mid. lat.	45	15		

TRAVERSE TABLE.

Courses.	Dist	N.	S.	E.	W.
S. ¼ E.	46		45.8	4.5	
S. by E. ¼ E.	30		29.1	7.3	
	Diff.	Lat.	74.9	11.8	Dep.

Yesterday's longitude	8°	8′	W.
Difference of longitude	0	17	E.
Longitude in	7	51	W.

To find the Bearing and Distance of Cape Ortegal.

Latitude in	44°	8′ N.
Cape's lat.	43	47 N.
Diff. lat.		21

NOTE, As the ship is in the same longitude as Cape Ortegal, but to the northward of it, consequently the Cape bears due south, and the difference of latitude is the distance.

NOTE. When the tenths on any side are more than 5, or half a mile, you must call that side one more than you found it to be; but when they are less than 5, then you need not take notice of them; as in the above the difference of latitude and departure are 74.9 and 11.8, which I call 5 and 12, because the tenths are above 5.

But when you take the difference of latitude and departure to find the course, then take them in miles and tenths; the same may be observed in casting up the knots and fathoms.

If, when doubled, the tenths are more than 5, set one mile more in the Traverse Table, but less, omit them, as there are no tenths in the distance column.

K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Thursday, May 10, 1810.
3	5	West.	S. S. W.	3	These 24 hours hard gales and squally
3	5				with small rains.—Handed the top sails,
3	5				fore and main courses. Brought to
Layed up N. W. by N. off N. by E.				5	under the mizen.
Drift 1 $\frac{1}{2}$ mile per hour W.					At 8 P. M. saw a ship to windward under
					jury masts.
Up N. W. off North.			W. by S.	5	Shipped much water.
Drift 1 $\frac{1}{2}$ mile per hour.					Wore. More moderate.
					Set the courses, a head sea
4		S. W.	N. W. by W.	$1\frac{1}{2}$	Set the top-sails close reefed.
5					C. Finisterre S. 30° 53′ W. dist. 83 m.
5					Variation $1\frac{1}{4}$ point westerly.

…rse.	Dist.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Diff. of Long.	Long. in	Bearing and Dist.
…V.		S.	W.	N.		W.		Funchal S.30 59 W.
…79°	20	4	19	44° 4′		27	8° 18′W.	Dist. 800 miles.

…king the middle points (viz. N. by W. and N. N. W.) between the point to which the ship …up, and the point she fell off to, for the second and third courses, as taught in the rules for …to, and then allowing as before for variation and leeway, the Traverse Table will stand as fol-

…th the diff. of lat. and dep. the course is S. 79° W. and the dist. 20 miles.

…of lat.	0°	4′ S		Mer. parts.
…rday's lat.	44	8 N.		2957
…ade in	44	4 N.		2951
…lats.	88	12	Mer. diff. lat.	6

TRAVERSE TABLE.					
Courses.	Dist.	N.	S.	E.	W.
W.N. W. $\frac{1}{4}$W.	21	7.1			9.8
N. N. E. $\frac{1}{4}$ E.	9	7.7		4.6	
N. by E. $\frac{1}{4}$ E.	9	8.5		3.0	
S. by W. $\frac{1}{4}$ W.	28		27.2		6.8

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Friday, May 11th, 1810.
2				Calm		The first 8 hours calm and foggy.
4						Up T. G. Y. out reefs, set T. G. S.
6						Hoisted the boat out, and tried the current, found
8						it to set N. W. by N. 1 mile per hour.
10	3	5	W. S. W.	South.	1	
12	4	4				Moderate and clear.
2	4	6				
4	4	8				
6	4	6				Variation $1\frac{1}{4}$ point westerly.
8	4	8				
10	4	8				
12	4	5				Cape Finisterre S. 38° 10′ E. dist. 52 miles.

Course.	Dist.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Diff. of Long.	Long. in.	Bearing and Dist.
		S.	W.	N.	N.	W.	W.	Funch. S. 26 55′.
S. 80° W.	84	15	83	43 49	43 34	1 55	10 0	W. dist. 736 m.

The variation and lee-way being allowed on the course steered, and the setting of the current and its drift in 24 hours being made a course and dist. the work will be as follows:

With the diff. of lat. and dep. the course is found S. 79° 57′ W. and the dist. 84 m.

Diff. of latitude	0° 15′ S.	Mer. parts.	
Lat. left	44 4 N.		2951
Lat. in	43 49 N.		2931
Sum of lats.	87 53	Mer. diff. lat.	20
Middle lat.	43 56		
	90 0		
Com. mid. lat.	46 4		

TRAVERSE TABLE

Courses.		N.	S.	E.	W.
N. W. $\frac{1}{4}$ W.	24	16 1			17 8
S. W. by W. $\frac{3}{4}$ W.	72		30.8		65.1
		16.1	30.8	Dep.	82.9
			16.1		
	Dif. Lat.		14.7		

The diff. of long. found by Mercator's sailing is 113 miles, but by mid. lat. is found 115 miles, equal to .... 1 55′ W.
Longitude left .... 8 18 W.

Longitude in by account .... 10 13 W.

The diff. of long. found by mid. lat. still differs from that found by Mercator's Sailing; the cause is the same as before, and as the ship has made so great a course, we will depend on mid. lat.

The lat. by observation differing from the lat. by account, I correct for the true longitude as follows (it being three days since I had an observation before) by Case II. p. 172.

Last obs. lat.	45° 23′ N.	M. pts.	3063
Ship's lat. by acc.	43 49 N.		2931
Mer. diff. lat. by account			132
Ship's long. at last observation.			8° 8′W.
Ship's long. in by acc. to-day			10 13 W.
Diff. long. since last obs.			2 5 W.
Last obs. lat.	45° 23′ N.		3063
Ship's lat. by obs.	43 34 N.		2910
Mer. diff. lat. by obs.			153

With the mer. diff. lat. by acc. 132 and diff. of long. by account 125, the direct course since last obs. is found S. 43° 26′ W. and the dist. 182 miles.—With that dist. and the mer. diff. of lat. by obs. 153, the dif. long. is found 98, this added to the diff. of long. by account 125, gives 223, which divided by 2, gives the true diff. of long. since last obs. 112 m. nearly, equal to 1° 52′W.
Long. in last observation 8 8W.
Long. in 10 0W.

The course found since last observation 44° 26′ is of no farther use than to know what Case to correct by.

To find the Bearing and Distance of Cape Finisterre.

Latitude in	43° 34′ N.	Mer. parts	2910	Longitude in	10° 0′ W.
Cape's lat.	42 53 N.	Mer. parts	2854	Cape's long.	9 16 W.
Difference of lat.	41	Mer. diff. of lat.	56	Diff. of long.	44

With the mer. diff. of lat. and diff. of long. the direct course to Cape Finisterre is found S. 38° 10′ E. and with that course and proper diff. of lat. the distance is found 52 miles.

Courses.	Winds.	Lee-way.	REMARKS on board, Saturday, May 12, 1810.
.W. by W.	S. by E.		These 24 hours moderate gales, with small showers of rain.
S. W.	S. S. E.	1	
			Var. per Az. 1 point west. A great swell from the S. W. for which I allow 6 miles.—Hazy weather.

Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Diff. Long.	Long. in.	Bearing and Dist.
S.	W.	N.		W.	W.	Funchal S. 23° 23′ W.
50	67	42° 44′		1° 33′	11° 33′	Dist. 660 miles.

k the swell is considered as a current, whose drift in 24 hours is 6 miles, the the swell; and as it comes from the S. W. it heaves the ship towards the N. allowed upon it makes the last course N. E. by N. as in the Traverse Table.

lat. and dep. the course is
/. and the dist. 84 miles.

° 50′S.		Mer. parts.
34 N.		2910
44		2841
18	Mer. diff. lat.	69
9		
0		

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S. W. by W.	58		32.2		48.2
S. W.	32		22.6		22.6
N. E. by N.	6	5.0		3.3	
		5.0	54.8	3.3	70.8
			5.0		3.3
	Diff.	lat.	49.8	Dep.	7.5

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks on board, Sunday, May 13, 1810.
2	4	5	W.	S. S. W.	1	These 24 hours fresh gales, and clear weather.
4	4	5				
6	4	5				
8	5					
10	5					
12	5					
2	5	5				
4	5	5	W. ½ N.	S.S.W.½W.	½	
6	5	5				
8	5	5				
10	5	5				
12	4					Variation 1 point westerly.

Course.	Dist.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Diff. Long.	Long. in	Bearing and Dist.
			W	N.	N.	W.	W.	Funchal S. 13° 9′ W.
W.	120		120	42° 44′	42° 30′	2° 43′	14° 10′	Distance 608 miles.

The variation being allowed on both the courses, and the leeway it will be found that the ship has sailed due west these last 24 hours, and by summing up the distances her whole distance is found to be 120 miles, which is also her departure; it is evident she has made no difference of latitude, therefore her latitude by account is the same as yesterday.

As the ship has sailed upon a parallel with the equator, her difference of longitude is found by parallel sailing. 2° 34′ W.
Yesterday's longitude 11 33 W.

Longitude in by account 14 16 W.

The latitude by observation not agreeing with the latitude by account, and it being two days since my observation, I correct as follows, by Case III. page 173:

Last obs. lat. 43° 34′ Mer. parts 2910
Lat. in by acc. 42 44′ Mer. parts 2841

Mer. dif. lat. by account since last obs. 69

Long. in at last observation 10° 0′ W.
Ship's long. by account 14 16 W.

Dif. long. by acc. since last obs. 4 16 W.

Last obs. lat. 43° 34′ M. parts 2910
This day's lat. by ob. 42 30′ M. parts 2822

1 4
Mer. dif. lat. by obs. since last obs. 88

With the mer. dif. of lat. and dif. long. by account, the course since last. obs. is found to be S. 75 W. and the distance 265 miles.

With that dist. and the mer. dif. of lat. by obs. the true dif. of long. since last observation is found to be 250 = 4° 10′ W.
Long. in at last observation 10 0 W.

Longitude in 14 10 W.

To find the Bearing and Distance of Funchal in Madeira.

Latitude in	42° 30′ N.	Mer. parts	2822	Longitude in	14° 10′ W.
Funchal's lat.	32 38 N.	Mer. parts	2073	Funchal's long.	17 5 W.
f. lat. 592 =	9 52	Mer. dif. lat.	749	Dif. longitude	2 55 = 175

With the mer. difference of latitude and difference of longitude the bearing of Funchal is found be S. 13° 9′ W. and with that bearing taken as before, and the proper dif. of latitude, the dis-ce is found 608 miles.

Courses.	Winds.	Lee-Way.	REMARKS on board, Monday, May 14, 1810.
S. S. W.	N. W.		Stiff gales, with showers of rain. Fresh gales.
S. ½ E.	S.W.byW.¾W.	½	Ditto weather. More moderate. Var. p. amp. 1 point westerly.

Dist.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Diff. Long.	Long. in.	Bearing and Dist.
	S.		N.	N.		W.	Funchal S.18°28'W
170	170		39 46	39 40		14 10	Distant 445 miles.

42° 30′ N.
2 44 S.

39 46 N.

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S. by W.	118		115.7		23.0
S. S. E. ¼ E.	54		48.8	23.1	
	Diff. Lat.		164.5	23.1	23.0
				23.0	
				0.1	Dep.

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Tuesday, May 15, 1810.
2	8		S. S. W. ¾ W.	W. by N. ¾ W.	½	Fresh gales and clear weather.
4	8					
6	8	5				
8	8	5				
10	8					
12	8	5				Ditto weather.
2	8	4				
4	8	4				
6	8	6				Variation ¾ point W. per Azimuth.
8	8	6				
10	8	5				
12	8					

Course.	Dist.	Dif. lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Diff. Long.	Long. in.	Bearing and Dist.
		S.	W.	N.	N.	W.	W.	Funchal S. 19° 44′
S. by W. ½ W.	192	184	56.	36° 29′	36° 36′	1° 11′	15° 21′	W. distant 242 m.

By examining the Log-board, it appears that the ship has sailed S. S. W. ¾ W. 200 miles.

Latitude left	39° 40′ N.
Dif. latitude	3 11 S.
Lat. in by account	36 29 N.

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S. by W. ½ W.	200	Dif. lat.	191 4	Dep.	58. 1

The latitude by observation not agreeing with the latitude by D. R. I correct as follows, by Case I. page 169.

With the course one point and a half, and the dif. of lat. by obs. 184, the dist. is found to be 192 miles, and the dep. 56.

Yesterday's latitude.	39° 40′ N.	Mer. parts	2597
This day's obs. lat.	36 36 N.	Mer. parts	2363
Sum of latitudes	76 16	Mer. diff. lat.	234
Middle latitude	38 8		
	90 0		
Comp. mid. lat.	51 52		

The diff. long. is found by Mercator or mid. lat.	1° 11′ W.
Yesterday's long.	14 10 W.
Long. in this day	15 21 W.

To find the Bearing and Distance of Funchal.

Latitude in	36° 36′ N.	Mer. parts	2363	Longitude in	15° 21′ W.
Funchal's lat.	32 38 N.	Mer. parts	2073	Funchal's long.	17 5 W.
Dif. lat. 238 =	3 58	Mer. dif. lat.	290	Dif. long. 104 =	1 44

With the mer. diff. of lat. and the diff. of long. the bearing of Funchal is found, and with that earing and the proper diff. of lat. the distance is found 242 miles.

Courses.	Winds.	Lee-way.	REMARKS on board, Wednesday, May 16, 1810.
W. by S.	S. by W.	1	These 24 hours moderate weather, with rain and much swell.
W. S. W. ¼ W.	S. ½ W.	¾	Less swell.
W. S. W.	South	½	Pleasant weather.
S. W. by W.	S. by E.	½	Varia. ¾ W. per equal alt. of the sun.

Dist.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Diff. of Long.	Long. in	Bearing and Dist.
	S.	W.	N.	N.	W.	W.	Funch. S. 7° 15′ E.
119	50	108	35 52	35 46	2 13	17 34	Dist. 190 miles.

of lat. and dep. the course
10′ W. and the dist. 118.6

36° 36′ N.	
44 S.	
35 52 N.	

36° 36′ N.	M. parts	2363
35 46 N.	M. parts	2301
50	M. diff. lat.	62

2 22

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
W. by S. ¼ W.	27		4 0		26.7
W. S. W. ¼ W.	31		10 4		29.2
S. W. by W. ¾ W.	43		18 4		38.9
S. W. ¼ W.	19		11 3		15.3
		Diff. lat.	44 1	Dep.	110.1

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Thursday, May 17, 1810.
2	6	6	S. by E. ½ E.	S. W. ½ W.	½	These 24 hours moderate gales, and clear weather.
4	5	8				
6	5	8				
8	5	8				
10	5	-	S. S. E.	S. W.	½	
12	5	2				
2	5	8				
4	5	5	S. S. E. ½ E.	S.W.byS½W	½	
6	5	5				Var. ¾ point westerly.
8	5	5				
10	5	6	S. E. by S	S. W. by W.	½	Unstowed the anchor and bent cables.
12	5	4				

Course.	Dist.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Diff. Long.	Long. in	Bearing and Distance.
S. 35° 20′ E.	135	S. 110	E. 78	N. 34° 1′	N. 33° 56′	E. 1° 33′	W. 16° 0′	Funchal S. 34° 40′ W. Distance 95 miles.

With the diff. of lat. and dep. the course is found S. 37° 48′ E. and the dist. 133 miles.

Yesterday's lat.	35° 46′ N.			
Diff. of latitude	1 45 S.			
Lat. by account	34 1 N.			
Obs. lat.	33 56 N.	M. parts	2167	
Yesterday's lat.	35 46 N.	M. parts	2301	
Prop. diff. lat. obs.	1 50	M. dif. lat.	134	
Sum of lat.	69 42			
Middle latitude	34 51			
	90 0			
Comp. mid. lat.	55 9			

TRAVERSE TABLE.

COURSES.	Dist.	N.	S.	E.	W.
S. S. E. ¾ E.	48		41 2	24 7	
S.E. by S. ¼ E.	31		24 9	18 5	
S.E. by S. ¼ E.	33		24 4	22 2	
S. E. ¼ E.	22		14 8	16 3	
	Diff. Lat.		105 3	81 7	Dep.

The lat. by obs. differing from the latitude by account, I correct as follows, by Case II. page 170.

With the diff. of lat. 110 and the dist. 133, the dep. is found to be 75, which being added to the former dep. 82, gives 157, half this sum is the true dep. 78 miles; with the dif. of lat, 110 and the dep. 78, the true course is found S. 35° 20′ E. and the dist. 135 miles.

The dif. of long. is found by Mercator or middle latitude sailing, to be	1° 34′ E.
Yesterday's longitude	17 34 W.
Longitude in	16 0 W.

To find the Bearing and Distance of Funchal in Madeira.

Latitude in	33° 56′N.	Mer. parts	2167	Longitude in	16° 0′W.
Funchal's lat.	32 38 N.	Mer. parts	2073	Funchal's long.	17 5 W.
Difference of lat.	1 18	Mer. dif. of lat.	94	Dif. of long.	1 5

With the merid. dif. of lat. and diff. of long. the direct course to Funchal is S. 34° 40′ W. *and with that course,* and the proper difference of latitude, the distance is found 95 miles.

.	Courses.	Winds.	Lee-way.	REMARKS on Friday, May 18, 1810.
5	S. by W.	E. N. E.		Moderate and hazy.
5				
5				
5				
4				
4				Made Porto Santo to the westward.
	W. $\frac{1}{4}$ S.	N. N. E.		Hauled round the S. end, and steered for Funchal.
				Cleared up, made the island Madeira.
5				Anchored in Funchal Road, hoisted out
5		N. N. W.		the boat, and waited on the Governor.

st.	Diff. Lat.	Dep.	Lat. by Acc.	Lat. by Obs.	Diff. Long.	Long. in	Bearing and Distance.
5	S. 78	W. 55	N. 32° 38′		1° 6 W.	W. 17 4	Off Funchal $\frac{1}{2}$ Mile.

riation allowed upon the course, with the distance run upon each course put
verse Table, will produce the difference of lat. and dep. as above, with the com-
f the middle latitude and departure, the difference of longitude is 66, which
16° 0′, the longitude in yesterday at noon, gives 17° 4′, the longitude in by ac-
d as it agrees with the longitude of Funchal in the table, I conclude that my
is just, and Funchal well laid down.

ip's place in the preceding Journal is pricked off, and the bearing and dist.
e also found by the chart, in order to show the young Navigator the method,
e done with a black-lead pencil, which he may either let stand or rub out when
.

n May 18, and June 3, lay moored in Funchal Road, Madeira.

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Monday June 4, 1810.
2	6	2	S. S. W.	N. N. E.		Light breezes and clear. Variation per amplitude 18° 30′ W.
4	3		S. S. W ¼ W.			
6	2					
8	2					
10	2					
12			Calm.			Made and shortened sail occasionally.
2	4	4	S. S. W. ¼ W.	W. N. W.		
4	5	4				
6	6					
8	6	3				
10	5	6		N. W		Fresh breezes and clear Set studding sails
12	4					Lat. by obs. 30° 31′ N

Course.	Dist.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Diff. Lon.	Long. in.	Bearing and Distance.
S. 1° 30′ E.	111	111	E. 2	30 31 N.	N. 30 31	E. 3 m.	W. 16° 33	Salvages, S. 56° 58′ E. Distance 42 miles.

Courses corrected.	Dist.	N.	S.	E.	W.
S. 55° E.	23		18 8	13 2	
S. 4 W.	12		12 0		0 8
S. 7 W.	81		80 4		9 9
			111 2	13 2	10 7
				10 7	
				2 5	

Lat. Deser. 32 22 N. M. P. 2054
✕ Lat. 1 51 S.

Lat. in 30 31 N. M. P. 1924

Sum 2)62 53 M. ✕ Lat. 130

Mid. Lat. 31 26 Com. Lat. 58 34
Lat. Sal. 30° 8 N. M. P. 1898 Long. 15 53 W.
Lat. in 30 31 N. M. P. 1924 Long. 16 33
✕ Lat. 23 M. P. 26 ✕ Long. 40

With the M. diff. lat. and diff. of long. the Salvage bears as above.

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on Tuesday, June 5, 1810.
2	6	4	South.	West.		Fresh breeze and clear, all sails set.
4	6	2				
6	5	0				Var. 18° W.
8	4	2				
10	6	3				
12	5	4				
2	5		S. by W.	W. by N.		Do. weather, two sails in sight.
4	5					
6	3					
8	3					
10	2	4				Light breezes.
10	2	1		W. by S.		In studding sails.

Course.	Dist.	✕ Lat.	Dep.	Lat. by Acc.	Lat. by Obs.	✕ Long.	Long. in.	Bearings and Distance.
S. 14° E.	107	S. 104	E. 26	N. 28° 47′	N. 28° 47′	E. 29	W. 16° 4′	Santa Cruz, Teneriffe, S. 28° 36′ W 16 m.

Courses corrected.	Dist.	N.	S.	E.	W
S. 18° E.	67		63 7	20 7	
S. 7 E.	41		40 7	5 0	
			104 4	25 7	

Lat. left 30 31 N. M. P. 19 24 Lon. St. Cru. 16 16 W.
✕ Lat. 1 44 S.

Lat. in 28 47 M. P. 1805 Long. in 16 4 W.

2)59 18 M. ✕ L. 119 Diff. Long. 12

M. Lat. 29 39 Lat. S. Cru. 28° 28′ N. M. P. 1783
Lat in. 28 47 N. M. P. 1805
C. M. L. 60 21
Diff. of Lat. 19 M. ✕ lat. 22

With the Mer. Diff. of Lat. and Diff. of Long. by Mercator the Bay of *Santa Cruz, in Teneriffe*, bears as above.

7.	Courses.	Winds.	Lee-way.	REMARKS on board, Wednesday, June 6, 1810.
4	S. S. E.	S. W.	1	Fresh breeze, and cloudy.
4				Handed top-gallant sails, and in first reef top-sails. At 6, the Peak of Teneriffe bore by compass W. S. W.
4	W. N. W.	Ditto.	1	Fresh breezes, and clear. Variation 18° W.
4				Set top-gallant sails. Hazy with rain. No land in sight.
4	S. S. E.	Ditto.	1	Light breezes, and clear. At noon made Teneriffe, bearing W. by N. dist. 6 or 7 leagues.
4				

Dist.	Dif. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Dif. of Long.	Long. in.	Bearing and Distance.
20	18 S.	8 E.	N. 28 29		E. 10 m.	W. 15 54	S. Cruz, Teneriffe, S. 87° 0′ W. D. 19 m.

being corrected for one point leeway, riation all these 24 hours, I find by able the direct course of the ship to list. 20 miles.

	0° 18′ S.	
	28 47 N.	
	28 29 N.	
	57 16	
	28 38	
it.	61 22	

Courses corrected.	Dist.	N.	S.	E.	W.
S. 52° E.	30		18 5	23 6	
N. 74 W.	24	6 6			23 1
S. 52 E.	10		6 2	7 9	
		6 6	24 7	31 5	23 1
			6 6	23 1	
	Dist.	lat.	18 1	8 4	Dep.

AN ABSTRACT OF THE FOREGOING JOURNAL.

Day: Week.	Day: Month. May.	Course.	Dist.	Lat. by Ac.	Lat. by Obs.	Long. in.	Bearings of Funchal.	Dist. Miles.
☉	6	S. 26° 33′ W.	107	48 21N.		6 26W	S. 27° 4′W	1059
☽	7	S. 30° W.	108	46 48N.		7 45W	S. 27°20′W	957
♂	8	S. 13° W.	97	45 12	45 23N.	8 8	S. 28 29	870
☿	9	S. 9° E.	76	44 8		7 0	S. 32 5	814
♄	10	S. 79° W.	20	44 4		8 18	S. 30 59	800
♀	11	S. 80° W.	84	43 49	43 34	10 0	S. 26 55	736
♄	12	S. 53° 30′ W.	84	42 44		11 33	S. 23 23	660
☉	13	West.	120	42 44	42 30	14 10	S. 13 9W.	608
☽	14	South.	170	39 46	39 40	14 10	S. 18 28 W.	445
♂	15	S. by W. ½ W.	192	36 29	36 36	15 21	S. 19 44W.	242
☿	16	S. 65° W.	119	35 52	35 46	17 34	S. 7 15 W.	190
♃	17	S. 35° 20′ E.	135	34 01	33 56	16 0	S. 34 10 W.	95
♀	18	Anchored in Funchal Road, and sailed 3d June for Teneriffe.						
	June.						Desertas. N. 55° W.	23
☉	3			32 10			Salvages.	
☽	4	S. 1° 30′ E.	111	30 31	30 31	16 33	S. 56 58 E.	42
							Santa Cruz.	
♂	5	S. 14 E.	107	28 47	28 47	16 4	S. 28 36 W	16
☿	6	S. 25 E.	20	28 29		15 54	S. 87 0 W	19
♃	7	S. 84 W.	19	Anchor'd in Santa Cruz road, ½ mile off shore.				

The method of finding the LATITUDE AT SEA, *by taking two altitudes, either in the forenoon or afternoon, leaving the intermediate time measured by a common watch, with ease and accuracy, independent of the Sun's meridian altitude.*

GENERAL RULES.

1st. To the secant of the latitude by account, add the secant of the sun's declination (rejecting their indexes), and call that sum the logarithm ratio*.

2d. From the natural sine of the greatest altitude, subtract the natural sine of the least altitude, and find the logarithm of their difference, and write it under the logarithm ratio.

3d. Subtract the hours and minutes when the altitudes were taken from each other, and half the difference call half elapsed time.

* The arithmetical comp. of the co-sine of any angle is equal to the logarithmic secant of that angle, omitting the first figure in the index; thus the secant of 46 deg. 50 min. is 10.16487, and omitting the first figure 1, leaves 0.16487, the secant less radius, or the arithmet. comp. of co-sine 46 deg. 50 min.

half the elapsed time enter the tables, and from the alf elapsed time take out the logarithm answering set it down under the logarithm ratio.

hese three logarithms together, and with their sum bles in the column of middle time, where having arithm nearest thereto, take out the time correspond- l put it down under half the elapsed time.

act the less from the greater, and the difference will from noon, when the greatest altitude was taken.

this time enter the tables, and from the column of out the logarithm corresponding to it; from this loga- ct the logarithm ratio, the remainder will be the loga- atural number, which being found in a common table s, and added to the natural sine of the greatest altitude, natural sine of the sun's meridian altitude.

e meridian altitude of the sun at noon, the latitude is usual method.

e latitude, found by the above process, should differ the latitude by account, it will be proper to repeat the sing the latitude last found instead of the latitude by the result gives a latitude nearly agreeing with the la- n the computation.

EXAMPLE I.

ea in latitude 46° 50′ north by account, when the sun's as 11° 17′ N. at 10 h. 2 m. in the forenoon, the sun's was 46° 55′, and at 11 h. 27 m. in the forenoon, the

Sun's zenith distance 10 S
Sun's declination 7 N

Latitude N

H. M. The observation at noon was

12 0
11 27

33 As the time agrees with the observation, the wat

EXAMPLE II.

Being at sea in lat. 47° 19′ N. by account, when the s clination was 12° 16′ N. at 10 h. 24 m. A. M. per watch, t alt. of sun's centre was 49° 9′; at 1 h. 14 m. P. M. his a 51° 59′. Required the latitude?

	H. M. S.				
	12 0 0				
	10 24 0				
		Alt.	Nat. S. Lat.	47° 19′	0.168
	1 36 0	49° 9′	75642 Sun's decl.	12 16	0.010
	1 14 0	51 59	78783		
			Log. ratio		0.1788
Ela. T.	2 50 0		Diff. N.S. 3141 Its log.		3.4970
½ El. T.	1 25 0		Its log. in col. of half elaps. time		[illegible]
Sub.	0 15 0		Col. of mid		[illegible]
Tr. Ti.	1 10 0		Its log. in		
Ti. p. W.	1 14 0		Log. ratio		
Wat. fast	0 4 0		3066 the nat. num.		
N. S. Sun's gr. alt. +			78783	90 0	
N. S. S. mer. alt.			81849 =	54 56	
Sun's zen. dist.			—	35 4 South	
Sun's decl.			—	12 16 North	
Lat. in			—	47 20 North.	

Here the latitude found by computation may be relied on, as it differs but one mile from that used in the operation.

EXAMPLE III.

Being at sea in lat. 50° 40′ North per account, when the sun's declination was 20° 0′ South, at 10 h. 17 m. A. M. per watch, the sun's alt. was found 17° 13′, at 11 h. 17 m. A. M. per watch, it was found 19° 41′. *Required* the latitude?

nes.		Alt. Nat. S.		
M.	S.		Lat. 50° 40′	0.19803
			Decl. 20 0	0.02701
17	0	17° 13′=29599		
17	0	19 41=33682	Log. ratio	0.22505
0	0	Diff. N.S. 4083	Its com. log.	3.61094
30	0	Its log. from col. half elap. time is		0.88430
1	0	Its col. of mid. time corresponding to		4.72032
31	0	From noon, its log. from col. of rising		2.96067
43	0	log. ratio sub.		0.22504
12	0	544 N. num. of		2.73563
		33682 N. S. greatest alt. +		
0′				
1		34226 N. S. the sun's mer. alt. 20° 1′.		
59 S.				
0 S.				
59 N.				

latitude differs 41 miles from that by account, it will repeat the operation, using the lat. last found instead account.

EXAMPLE IV.

Being at sea in latitude 60° 0′ north by account, when the sun was on the equator, and consequently had no declination, at 1 H. 0 M. P. M. per watch, his altitude was 28° 53′, and at 3 H. 0 M. P. M. per watch, it was 20° 42′. Required the true latitude?

Times.						Lat. 60° 0′ =	0,30103
	H.	M.	S.	Alt.	N. S.	Dec. 0 0 =	0,00000
	1	0	0	28 53 =	48303		
	3	0	0	20 42 =	35347	Log. ratio	0,30103
Elap. T.	2	0	0		12956	Its log.	4,11247
½ El. T.	1	0	0	Its log. in col. of ½ Elap. time			0,58700
	2	0	0	Its log. in col. of mid. time			5,00050
T. fr. N.	1	0	0	Its log. from col. of rising			3,53243
D. per W.	1	0	0			Log. ratio	0,30103
				1704	N. num.		3,23140
				48303	N. S. of greatest alt. +		
					90° 0′		
Nat. S. Sun's mer. alt.				50007 =	30 0 Sun's merid. alt.		
					60 0 Latitude		

The latitude by computation, coming the same with the latitude by account, shows that the latitude by account was right. From the foregoing examples it is plain, that the operation is the same, whether the sun hath north or south declination. And it will be the same whether the ship is in a north or south latitude. It is also clear, that when the sun has no declination, the secant, rejecting the index of the latitude, is the log. ratio.

EXAMPLE V.

Wanting to go through the N. Channel among the Maldives, and by account being in latitude 7° 40′ N. the declination being then 22° 47′ N. at 7 H. 25 M. 40 S. A. M. the true altitude of the sun's centre was 22° 30′, and at 10 H. 31 M. 48. S. A. M. it was found 63° 40′. Required the ship's true latitude.

	H.	M.	S.	Alt.	Nat. S.	Lat. by ac.	7° 40′	0,00390
Times	10	31	48	63° 40′	89623	Declin.	22 47	0,03528
	7	25	40	22 30	38268			
						Log. ratio.		0,03918
Elap. T.	3	6	8		51355	Its log.		4,71058
½ El. T.	1	33	04	Its. log. in col. of ½ elap. time is				0,40368
							H. M. S.	
	3	1	30				3 1 30	5,15344
True T.	1	28	26	Its log. in col. of rising is				3,86709
T. p. W.	1	28	12			Log. ratio		0,03918
W. slow	0	0	14		6728	Nat. num.		3,82791
		90	00		89623	N. S. gr. alt.		
Mer. alt.		74	29					
					96351	N. S. sun's mer. alt. = 74° 29		

en. dist. 15 31 N.
ecl. 22 47 N.

at. in 7 16 North.

s the Tables are only calculated to 10 seconds, the log. ermediate second is found by taking the difference be- og. next greater and next less; and saying, As 10 se- that difference, so is the given seconds to the difference rithms; or, if it be any even part, take such a part of ce, and apply it to the next less logarithm; but in these a few seconds are not regarded.

SECOND OPERATION.

	Lat.	7° 16′	0,00350
	Dec.	22 47	0,03528
	Log. ratio		0,03878
H. M. S.			4,71058
3 1 20			0,40368
1 33 4		H. M. S.	
		3 1 20	5,15304
ne 1 28 26			
			3,86709
t. — 89623	Log. ratio		0,03878
6735 N. num.			
	Log.		3,82831

m. alt. 96358=74 29. Hence the lat. in is 7° 16′ N.

Again, if the ship sails or makes towards that point of the compass which the sun bears upon, she must raise the sun's altitude as many minutes as the miles she has run towards it; therefore the miles run towards the sun must be added to the first altitude; but if sailing from the sun, the same must be subtracted: if they are but few, they are not worth minding; and then the seaman may make a very good estimation by looking at the log-board only, who by that will be able to ascertain the distance sailed to or from the sun, between the observations, which will be of sufficient exactness in the practice of navigation; and if the ship makes an angle with the sun's bearing, it may be readily found by the Table of Difference of Latitude and Departure, and then either add or subtract, according as the case requires; as may be seen in the following examples, which are inserted for the benefit of those who require a greater degree of accuracy.

EXAMPLE VI.

Suppose a ship from the Bay of Biscay, bound to the English Channel, in a brisk gale running N. by E. ¾ E. per compass, at the rate of nine knots per hour, at 10 H. 0 M. A. M. per watch; observed the sun's altitude 13° 18′ bearing S. ¾ E. by compass, and at 1 H. 40 M. P. M. per watch, the sun's altitude again was found 14 15, the latitude by account being 49° 17′ N. and the sun's declination 23° 28 S. Required the true latitude.

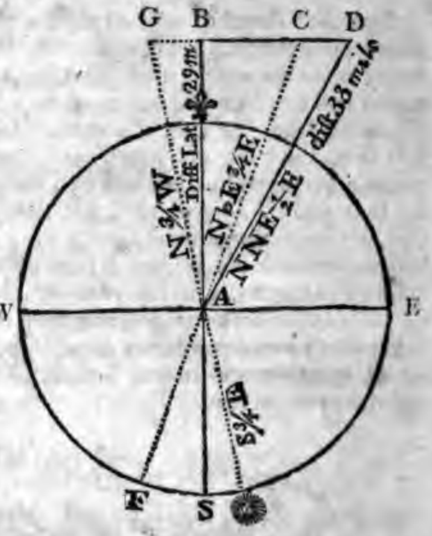
Correction of the first Altitude.

The time of the first observation is 10 H. 0 M. A. M. and of the second 1 H. 40 M. P. M. the elapsed time is 3 H. 40 M. and the rate of sailing is 9 miles per hour; then say, by the Rule of Three, As 1 H. is to nine miles, so is 3 H. 40 M. to 33 miles, the distance run in the elapsed time.

Again, the sun's bearing at the first observation is south ¾ E. the opposite to which is N. ¾ W. or ¾ point, and the ship's course during the elap. time is N. by E. ¾ E. 1¾ points, so the angle of ship's course with the sun's bearing is 2½ points.

Now in the Table of Difference of Latitude and Departure, to the course 2½ points, and distance 33, the difference of latitude is 29 miles, the ship sails from the sun: therefore from the first observed altitude 13° 18′ take 29′, the remainder 12° 49′ is the first altitude corrected, which is to be used in the operation, as follows:

2 D 2



circle represent
ss N, S, E, W,
e ship's place.
ship's course N.
or 1¼ point, and
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ng S. ¾ E. or ¾
, and set it off
outh towards the
opposite point is
W.: then will
he angle the ship
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h angle being set
e north (or me-
e east, will be the
e the ship has
the sun, as the
D. From A to D
niles, the distance sailed in the elapsed time; from D
parallel to the E. and W. to cut the north or meridian
then A B will be the difference of latitude 29 miles,
ip has sailed from the sun during the elapsed time,

H. M. S. Alt. Nat. S. Lat. 49° 17′ 0,18554

			Log. ratio	0,22011
		H. M. S.	Diff. N. S. 2432 Its log.	3,38596
		1 50 0	Its log.	0,33559
		0 10 0	Time answering to	3,94166
	90 0	1 40 0	Its log. in col. of rising	3,97170
	17 37		Log. ratio	0,22011
Zen. dist.	72 23 S.	5644	Nat. num. of	3,75159
Declina.	23 28 S.	24615	Nat. sine of the greatest alt. +	
Tr. lat.	48 55 N.	30259	N.S. mer. alt. 17° 37′.	

This latitude differing only two miles from that in the above computation, it may be depended upon as the true latitude.

EXAMPLE VII.

A ship sailing N.E. half E. by compass, at the rate of nine knots an hour, at 0 H. 31 M. 40 S. P. M. per watch, I found the altitude of the sun's lower limb 28° 20′ above the horizon of the sea, the eye being elevated twenty feet above the surface of the water, and the sun's bearing by compass being at the same time S. by W. and at 2 H. 58 M. 20 S. P. M. by watch, the altitude of the sun's lower limb was 16° 41′ above the horizon, the eye being elevated as before, and the latitude by account, at the time of the last observation, was 48° 5′ north, and the declination 13° 17′ south. Required the true latitude at taking the last observation.

First observed alt. sun's lower limb	28° 20′	Second ditto 16° 41′
Refraction to be subtracted	2	3
Correction for refraction	28 18	16 38
Dip of the horizon subtracted	4	4
App. alt.	28 14	16 34
Sun's semidiameter added	0 16	0 16
Correct altitude of sun's centre	28 30	16 50

Correction for the first Altitude.

The time of the first observation 0 H. 31 M. 40 S. P. M., of the second 2 H. 58 M. 20 S. P. M.; so the elapsed time is 2 H. 26 M. 40 S.: the rate of sailing is nine miles per hour. Then as 1 H.: 9 miles:: 2 H. 26 M. 40 S.: 22 miles, the distance run in the elapsed time.

Again, the sun's bearing at the first observation is S. by W. the opposite point to which is N. by E. or 1 point.

The ship's course during the ela. time is N. E. ½ E. or 4½ pts. so the angle of the ship's course with the sun's bearing is } 3½ pts.

le of difference of latitude and departure, to the course nd distance 22 miles, the difference of latitude is 17 ı the ship sails from the sun.

e, first observed altitude 28° 30′—17′=28° 13′ the first ıde to be used in the operation.

M. s.	Alt.	N.S.			
31 40	28° 13′	47281	Lat. by ac.	48° 5′	0,17519
58 20	16 50	28959	Declin.	13 17	0,01178
			Log. ratio		0,18697
26 40	Diff. N. S.	18322	Its log.		4,26297
13 20	Its log. from col. of ½ elaps. time				0,50232
46 27	In col. of mid. time corresponding to				4,95226
33 7	Its log. from col. of rising				3,01794
	Log. ratio				0,18697
	N.S. gr. alt.	47281			
90 0		678	N. numb. of		2,83097
28 40	N. S.	47959			
61 20					
13 17					
48 3 N.					

compass. At 2 H. 58 M. 20 S. P. M. his altitude was 16° 40', the height of the eye 20 feet, his declination being then 13° 17' S. and the latitude then by account 47° 37' N.: the ship's course during the elapsed time was N.E. with her larboard tacks on board, sailing at the rate of six knots, and made half a point lee-way. What latitude was she in when the last altitude was taken? Answer 47° 34' N.

By the ship's course per compass is to be understood its course made good; lee-way, if any, being first allowed; or the course, by compass, corrected for the lee-way only, but not for the variation. Had the variation of the compass been applied, both to the ship's course and the sun's bearing, it would not have made any difference in the operation or result, as the angle formed by them will always be the same, whether they are both estimated by the compass, or when the variation is allowed on both.

This method of finding the latitude is of excellent use, since there are so many circumstances at sea, which deny the opportunity of having the sun's meridian altitude; and as the knowing the true latitude is of the greatest consequence, especially in coming into the English channel, &c. where there are frequent obstructions of clouds, every seaman ought to be ready at determining his latitude by this method, whenever an opportunity offers, lest he should not see the sun upon the meridian.

Note. The nearer to noon the observations are taken, the better; provided the elapsed time be not much less than half the interval of time, when they are both taken on the same side of noon; nor much greater than once and half the greater interval, when taken on different sides of noon.

To find the Latitude *by one* Altitude *of the Sun, when the Time is not more distant than one Hour from Noon.*

RULE.

To find the true Time.

When the sun's declination and complement of the latitude re both north or both south, their sum, but if one be north and he other south, their difference, is the meridian altitude.

From the natural sine of the sun's meridian altitude, subtract the atural sine of the observed altitude.

Then add together,

The log. co-secant of the comp. of the lat. } reject their indexes,
The log. secant of the sun's declination, }

nd the common logarithm of the difference of natural sines, into e sum. The sum of these three logarithms being found in the lumn of rising, the hours, minutes, and seconds, corresponding to will be the true time from noon when the altitude was taken.

EXAMPLE.

Being at sea in latitude 50° 4' N. by account, when the sun's de-

s 20^{0} south, at 11 H. 17 M. A. M. per watch, sun's 40'. Required the true time.

39 56 N.		Co-sec.	0,19254	
20 00 S.		Sec.	0,02701	
19 56 Nat. sine 34093				
		L. ra.	0,21955	
19 40 Nat. sine 33655				
	438	Com. L.	2,64147	H. M. S.
				12 00 00
Log. in col. of rising			2,86102 is =	00 27 38
		True time at sea		11 32 22

he true time previous to the observation, to find the ltitude.

her the logarithm found in the col. of rising, answering tes and seconds the sun had to rise when the altitude nd the secant of the supposed meridian altitude from e index being increased by 5*) subtract the log. ratio, ler is the log. sine of the change of altitude from the rvation to noon; which, being added to the observed es the sun's meridian altitude.

of rising of 27 M. 38 S.	2,86102	Obser. alt.	19.40
. alt. 19^{0} 56' + 5 Index	5,02683	Cha. of alt. +	16
	7,88785	Tr. m. alt.	19.56

EXAMPLE III.

Being at sea in lat. 39° 28′ north by account, sun's declination 20° 41′ north at 26 M. 28 S. P. M. sun's alt. was 71° 10′. Required the true time and latitude at the ship.

Comp. lat.	50.32N.		Co. sec.	0.11239
Declination	20,41N.	Nat. sine 94674	Secant	0.02893
Sup. m. alt.	71.13	Nat. sine 94646	L. ratio	0.14132

Obser. alt.	71.10	28 Com.log.	1.44716	
Chan. alt.	3			M. S.
		Log. in col. of rising is =	1.58848	= 6 30 T.T.
T.mer. alt.	71.13	Log.sec.sup.mer.alt. +	5.49216	[at sh.
Zen. dist.	18.47 S.		7.08064	
Declination	20.41N.	Subtract log. ratio	0.14132	
Lat. in	39.28N.	L. sine chan. of alt. 3 m.	6.93932	

NOTES.

1st. The altitudes for determining how much the watch differs from apparent time had better be taken in the morning, or evening, when the sun's altitude does not exceed 18 degrees.

2d. An error in the supposed latitude can make very small difference in the change of altitude; and the nearer the altitude is taken to noon the better to find the change of altitude.

3d. This method is not to be depended on should the apparent time exceed an hour from noon, and, in some instances, not then; such as altitudes taken near the equator; or when the meridian altitude exceeds 60 degrees; nor is there much occasion for this method, or that of the double altitudes there, since there is generally a clear horizon, and consequently a meridian altitude is easily obtained.

To find the Latitude by the Meridian Altitude of the Moon.

To the longitude of the given place in time add the number rom (T.XVI.) corresponding to that longitude, and the daily ariation of the moon's passage over the meridian on the given lay, (Nau. Alm. p. vi.) if the longitude be west; but subtract the um if the longitude be east: the sum or difference will be the ime at Greenwich when the moon was on the meridian of the iven place.

In page 7th of the month in the almanack, find the moon's emi-diameter, and horizontal parallax, at the nearest noon, or nidnight, to the reduced time, which will be sufficiently accurate or the purpose of finding the latitude. For parallax, see the use f the sextant.

Take the difference between the moon's semidiameter and dip, nd add it to the observed altitude, if the lower limb was observed, ut subtract their sum if the upper limb was observed; the sum or ifference will be the apparent altitude of her centre.

From the proportional logarithm of the moon's horizontal paralx, increasing its index by 10, subtract the log. co-sine of

O F

the moon's apparent alt., the remainder will be the prop. log. of the moon's parallax in altitude, from which take her refraction, the difference will be a correction, which, being added to the apparent altitude, will give the true altitude of her centre: hence the zenith distance, to which apply her declination, and you will have the latitude.

NOTE. The moon's declination is set down in page the 6th of the month for every noon and midnight in the Nautical almanack.

Therefore find the declination for the nearest noon and midnight, both before and after the reduced time, and take the difference.

From (T. XVIII.) take out the number corresponding to the hours at top, and the minutes in the left-hand column, with the time at Greenwich, with which multiply the difference; from the product cut off four figures from the right hand, the remainder is a correction to be added to the declination, if increasing, but subtracted if decreasing; the result will be the declination at the given time.

EXAMPLE I.

Suppose, on Sep. 16, 1810, in longitude 45° W. the altitude of the moon's lower limb, when on the meridian, south of the observer, should be 60° 43′ 0″, the eye being 23 feet above the sea. Required the latitude.

The longitude 45° west turned into time equal to 3 hours, and the correction 6 m. from (T. XVII.) added to 15 h. 12 m. the time the moon passes over the meridian on the given day, gives 18 h. 18 m. time at Greenwich.

Hor. par.	57′ 21″ P. L.	10,4967	Moon's ob. alt.		60° 43′ 0″
App. alt. 60 52	L. co-si.	9,6874	M. sem. dia.	15 38	+ 11 2
			Dip	— 4 36	
Par. in alt. = 27 55	P. L.	8093			60 51 58
Refrac.	— 23				
	27 32		Cor. of the moon's alt. +		27 32
Moon's dec. midnight	12° 25′ N.		True alt.		61 19 30
Do. at noon	23 52 N.		Dec. 12° 25′		90
Diff. in 12 hours	1.27 +		Zen. dist.		28 40 30
Then 1.27 × by ,5250 (T. XVIII.) gives			+46		
Moon's dec. at reduced time			13 11		13 11 0 N
			Latitude		41 51 30 N

EXAMPLE II.

Suppose, on Dec. 14, 1810, in longitude 60° *east*, the altitude of the moon's *upper* limb should be observed, when on the meridian, being then south, 54° 30′, the eye 20 feet above the sea. Required the latitude.

The longitude 60° east in time equal to 4 hours, less the correction 8 m. found in (T. XVII.) subtracted from 15 h. 15 m. the time the moon passes over the meridian on the given day, leaves 11 h. 23 m. time at Greenwich.

Hor. par. 54′ 15″ P. L.	10,5209	Moon's ob. alt.	54° 30′ 0″
App. alt. 54° 9 0 co-si.	9,7676	M. sem. dia. 14′ 48″ ; Dip — 4 17	— 10 31
Par. in alt. 31 46 P. L.	7533		
Refrac. — 41			54 19 29
31 5		Moon's cor. to be added +	31 5
Moon's dec. at noon	15° 33′ N.	15° 33′ 0″ N.	54 50 34
Do. at midnight	14 26 N.		90
	1 7	Zen. dist.	35 9 26 S
1° 7′=67′ ×by 9486 gives 64′=1° 4′ (T. XVIII.)		1 4	14 29 0 N
Moon's dec. at reduced time		14 29 0 N. Lat.	49 38 26 N

To find the Latitude by the Meridian Altitude of a Planet.

In page 4th of the month in the Nautical Almanack, are given the declinations and times of the planet's passage over the meridian of Greenwich every six days.

Reduce the longitude into time, and add it to, or subtract it from, the times of their passage over the meridian of Greenwich, according as the longitude is east or west: the sum or difference will be the time they pass the meridian of the place of observation: correct the observed altitude for the dip and refraction, with this corrected altitude and declination find the latitude.

EXAMPLE I.

Suppose, in longitude 15° west, on Dec. 19, 1810, the meridian altitude of Jupiter, when south of the observer, should be 59° 12′, the eye being elevated 22 feet above the surface of the sea, and the latitude be required.

By the Nautical Almanack, Jupiter passes the meridian of Greenwich that day at 9 h. 33 m. afternoon; and 1 h. the longitude in time added to it, gives 10 h. 33 m. the time of his passage over the meridian of the place of observation.

Mer. alt.	59° 12′ 0″
Dip 4′ 30″ + Refra. 34″	5 4
	59 6 56
	90 0 0
Zen dist.	30 53 4 S
Decl.	17 29 0 N
Lat.	48 22 4 N

EXAMPLE II.

, in lat. by account, 47° 12′ N. and lon. 15° W. bound
lish Channel, and having had no observation for several
d the meridian altitude of Venus, bearing south of me,
he eye being elevated 22 feet above the horizon, and
tion 23° 51′ 0″ S. Required the latitude.

Mer. alt.	18°	15′	0″
″ + Refra. 2′ 52″	00	7	22
True alt.	18	7	38
	90	0	0
Zen. dist.	71	52	22 S
Decl.	23	51	0 S
Lat.	48	1	22 N

A

NDIUM OF NAUTICAL ASTRONOMY.

EXAMPLE I.

At what time will the star Arcturus be on the meridian of Greenwich, Dec. 1, 1810?

	H.	M.	S.
Arcturus right asc.	14	6	39
	24		
	38	6	39
Sun's right asc.	16	27	53
	21	38	46
	12		
In the morning	9	38	46

That is, the star Arcturus will be on the mer. of Greenwich 39 min. after nine in the morning.

EXAMPLE II.

At what time will the star Virgin's Spike be on the mer. of Greenwich, Sept. 1, 1810?

	H.	M.	S.
Virgin's Spike right asc.	13	14	12
Sun's right asc.	10	39	55
The star culminates	2	34	7

So that the star Spica Virginis, or Virgin's Spike, comes to the meridian of Greenwich at 34 minutes after two in the afternoon.

To find what Star comes on the Meridian at a given Time.

RULE. Add the time from noon to the sun's right ascension, he sum will be the right ascension of the star required to be known; ook in the table of the star's right ascension, and find what star's ight ascension agrees with, or comes nearest to it; and that is he star required.

EXAMPLE I.

would know what star will be on the meridian of Greenwich about ten at night, Jan. 26, 1810.

	H.	M.	S.
asc. for noon. Jan. 26,	20	33	23
d for 10 h. more		2	
given time 10 P. M.	10	0	0
	30	35	23
	24	0	0
early answ. to Sirius	6	35	23

EXAMPLE II.

What star will be upon the mer. of Greenwich 30 minutes past 4 A. M. May 10, 1810?

	H.	M.	S.
☉ right asc. May 10 at noon and for 16 H.	3	6	39
		3	
more given time 16 hours 30 min. from noon of the 10th=	16	30	0
Answering nearly to Altair	19	39	39

Having found the time of the star's coming to the meridian by e foregoing method; in order to determine whether you have served by the right star, observe the following rules:

1st. If the latitude in and declination be of the same name, subct the declination from the latitude, the diff. subtracted from ' gives the latitude.

2d. If the lat. and dec. be of contrary names, add the dec. to : lat. the sum subtracted from 90° gives the alt. of the star juired.

EXAMPLE I.

What will be the altitude of Arcturus at Greenwich when on the meridian Jan. 25, 1810?

	H.	M.	S.
Lat. of Greenwich	51	28	40N.
✳ Declination	20	10	34N.
	31	18	6
	90		
✳ Altitude	58	41	54

EXAMPLE II.

What will be the altitude of the star Virgin's Spike at Greenwich, Sept. 1, 1810?

	H.	M.	S.
Lat. of Greenwich	51	28	40N.
✳ Declination	10	9	51 S.
	61	38	31
	90		
✳ Altitude	28	21	29

Of the Celestial Globe.

The Celestial Globe is a round body, upon the surface of which is represented the concavity of the heavens; that is to say, a right line being drawn from the eye of the spectator, placed at its centre through any star thereon represented, will point to the same star in the heavens; whence it follows, that the celestial globe being elevated to the latitude of a given place, the sun's place in the ecliptic brought to the brazen meridian, and the hour index set to the upper twelve, by turning the globe round to any given hour, all the stars represented on the globe will point to their corresponding stars in heavens; thus exhibiting all the stars at that time visible above the horizon.

From these data the following problems may be solved.

PROBLEM I.

Required the time of rising, passage over the meridian, and setting, of the star Regulus, on the 6th of Jan. 1810, in lat. 52° north.

First, elevate the pole as many degrees above the horizon as correspond with the given latitude, which, in this instance, is 52° north: then look in the horizon for the day of the month, which is the 6th of Jan. opposite to which stands 16° of Capricorn; find 16° of Capricorn on the ecliptic, and bring it to the eastern side of the brazen meridian; set the hour index to the upper twelve; then, by turning the globe round, you will find the star Regulus rises 18 minutes before eight in the afternoon, comes to the meridian 10 minutes before three in the morning, and sets 2 minutes before ten in the forenoon.

PROBLEM II.

Required the altitude and azimuth of the star Regulus, at eleven o'clock in the afternoon of the 6th of January.

The sun's place being brought to the brazen meridian, as before, and the hour index set at twelve; screw the quadrant of altitude in the zenith, or over 52°, counted on the brazen meridian, from the equinoctial; turn the globe to the westward, till the hour *index points to* eleven; then lay the quadrant of altitude over

he centre of the star, and you will find its altitude, counted on he graduated edge of the quadrant, 30°, and its azimuth 18° east, outherly; that is, 108°, reckoned from the north point of the ompass.

Thus may the time of rising, passage over the meridian, and etting, of any star, together with its altitude and azimuth, be ound. But as ships are seldom provided with globes, we shall ndeavour to work such problems as are necessary for seamen to now, by the plans subjoined to this 18th edition.

The first plan divides the celestial globe into two equal parts, he northern and the southern hemisphere, extending from the quinoctial to each pole. Upon the equinoctial is marked in time nd degrees, the right ascension, beginning at the first point of ries, and reckoning to the eastward, including 360°, or 24 ours.

The declination is reckoned in degrees, beginning at the equi- octial, and counting towards each pole, ending at 90°.

The ecliptic begins also at the first point of Aries, and ends at ibra, extending in the northern hemisphere nearly 23° 28′. The her part of it begins at Libra, extends nearly 23° 28′ southerly, d ends at Aries again. On this circle are marked the twelve gns of the zodiac, in which may be found the sun's place for ery day in the year. From this it is clear, any star may be und, whose right ascension and declination are known.

EXAMPLE I.

Required to find the star Regulus.

Enter Table XV. where you will find the star's right ascension 149° 33′ 30″, and declination 12° 53′ 29″ N. nearly.

Lay a ruler from the pole over the right ascension; take the clination in your compasses, and set it off by the side of the er from the equinoctial, and that will give the place of the star quired.

EXAMPLE II.

Required to find the star Aldebaran.

Enter Table XV. where you will find the star's right ascension 66° 15′ 30″, and declination 16° 7′ 8″ N. nearly.

Lay a ruler from the pole over the right ascension; take the de- nation in your compasses, and set it off by the side of the ruler m the equinoctial, and that will give the place of the star uired.

EXAMPLE III.

Required to find the star Antares.

n Table XV. before directed, find the star's right ascension and lination, which in this instance is 244° 26′ 30″ right ascension, declination 25° 59′ 51″ S. nearly.

ay a ruler from the pole over the right ascension; take the de- ation in your compasses; set it off along the ruler from the inoctial, and it will give the star's place as required.

jection of the celestial globe upon the plane of the sufficient for the purpose of finding the stars in either , independent of the other. But as it may in many e necessary to trace the relative situation of the stars in pheres, another plan has been subjoined, which, it is ll, together with the foregoing one, answer every e mariner may find himself in.

ery difficult to lay down a sphere on a plane, the fol- hod has been suggested: that is, by laying down the on a plane, and the hour circles extended in the same as the degrees on the equinoctial, having the distance north and south expanded so as to correspond nearly circles upon the globe itself, by which means the right nd declination will cut each other at right angles; the ed from the first point of Aries, and the latter from ctial, either north or south, having the ecliptic laid down rmer plan. This plan being laid flat, pointing N. S. show the face of the heavens. The right ascension tion of a star being given, it may easily be found by ler over the right ascension, and taking the degree of in the compasses, and laying it off from the equinoc- de the ruler. To prove which, let us make use of f the three foregoing examples. Thus, by laying a the right ascension of Regulus, which is 149° 33′ 30″, the declination 12° 53′ 29″ N. in your compasses, and f by the ruler, counting from the equinoctial, you will

2d. Required to know the star Aldebaran, Nov. 25, 1810.

By the foregoing rules, I find that the star Aldebaran comes to the meridian at 0 h. 22 m. 52 s. in the morning. For farther satisfaction, I compare his altitude with my latitude; and further, I find the star Capella bearing N. by E. ¾ E. distant about 30°; Betelgeux, E.S.E. 29°; Bellatrix, S.E. ½ E. 21°; and Pleiades, W. N. W. 15°.

3d. To know the star Pollux. Find the time of his coming to the meridian as before, when you will see the following stars, viz. Acubens, bearing S. E. easterly, distant 26°; Procyon S. 22°; and Castor N. W. by W. 5°.

4th. To know the star Regulus. Find the time of his culminating, as before; and further, you will see the two stars in the constellation of the Great Bear, called the Pointers, in the following bearings, viz. the Lower Pointer, N. by E. 45°; Dubhe, or the Upper Pointer, N. ¾ E. 50°—N. B. A line drawn directly through the Pointers leads within a degree of the north-pole star.

5th. To know the star Virgin's Spike. Find the time of her culminating; and further, you will see the star marked *a*, in the constellation of the Cross, bearing S. by W. distant about 53°; and a bright star amongst the Oars, marked *β*, bearing S.S.W. 71°.

6th. To know the star Antares. Find the time of his culminating, as before; and further, you will see the star Zubenelg, bearing N. W. by W. 29°; and Zubenesch, W. by N ½ N. 30°.

7th. To know the star Altair, or *α* Aquilæ. Find the time of his coming to the meridian, as before directed; and further, you will see the star Lyra, bearing N. N. W. westerly, distant about 36°; and Ras Alagus, W. by N. 46°; Ras Algethi, W. by N. northerly, 52°.

8th. To know the star Fomalhaut, in the mouth of the Southern Fish. Find the time of his coming to the meridian, as before directed; and further, you will see the bright star in the tail of the Whale, marked *β*, bearing E. N. E. 32°; Achernar, S. E. by S. 1°; and a star in the preceding wing of the Crane, marked *α*, bearing S. S. W. 21°.

9th. The star Markab, or *α* Pegasi, will be known by finding the time of his culminating, as before; and further, you will see the star Denib, bearing N. W. by N. 46°; Alderaimin, N. by W. W. 52°; and Scheat, N. 13°.

The bearing and distance of a great number of the principal stars are here given, making those from which the moon's distance is computed in the Nautical Almanack severally the focus. These directions may with ease be reduced to practice, by taking the distance with a sextant or quadrant, and the bearing by the compass, allowing the variation.

Observing these rules will, in a short time, render seamen expert in knowing the principal fixed stars.

N. B. The method of knowing the planets is given in the description, Table XX.

TO FIND THE APPARENT TIME, AND THEREBY REGULATE THE GOING OF THE WATCH.

IT is necessary here to premise, that there are three divisions of time in use, the Civil, the Astronomical, and the Nautical. The civil day begins at midnight, and ends at the midnight following, being divided into two equal parts of 12 hours each; the first 12 being marked A.M. that is, ante meridiem, or before noon; the latter 12, P.M. that is, post meridiem, or afternoon. This division of time is most generally used.

The Astronomical Day, so called from its being used by astronomers, begins at the noon of the civil day, and continues to the noon of the civil day following (the hours being counted in regular succession from 1 to 24) so that the first part of the astronomical day is the last part of the civil day: and the last part of the astronomical day includes the first part of the civil day following.

The Nautical Day, in use amongst seamen, is, in one respect, the direct reverse of the astronomical day, as it ends when the astronomical day begins. This it has in common with the civil day, that it is divided into two equal parts of 12 hours each, but the first twelve hours are marked P.M. and the latter 12 A.M. An example will best illustrate this. By the sea reckoning, Tuesday begins immediately after meridian on Monday; all occurrences happening from Monday noon to midnight, though the first part of Tuesday by the nautical reckoning, are marked as happening at such an hour P.M.; and all occurrences happening from midnight to Tuesday noon, are marked as happening at such an hour A.M. Thus it appears that the hours in the nautical day are regulated by the civil day, but the nautical day itself begins 12 hours before the civil day. I have been the more explicit on this subject, as I do not remember to have seen it clearly elucidated in any book of navigation extant. From what has been said, it will appear, that the noon of the civil day, the beginning of the astronomical day, and the end of the nautical day, take place at the same time.

The different kinds of time are two, mean and apparent. Mean time is that shown by a clock or watch, regulated to mean solar time. Apparent time is reckoned from the passage of the sun over the meridian of any place. Mean and apparent time will sometimes differ from each other near a quarter of an hour, owing to the irregularity of the earth in her orbit, or the variation in the inclination of her axis. This difference is called the equation of time, and is contained in page 2, in the Nau. Alm. It is only requisite to take notice of it in determining the longitude by a time-keeper, but not in any other nautical observation, as the *calculations* in the Nau. Alm. are adapted to apparent time.

To find the Apparent Time by equal Altitudes of the Sun.

Take the sun's altitude at any convenient time in the forenoon, 2, 3, 4, or 5 hours distant from the meridian; set down the altitude with corresponding time by watch exactly; set the index to the same altitude, and wait till the sun comes to that altitude in the afternoon; note the time by watch; half the sum of these two times is the apparent time shown by the clock or watch, when the sun was on the meridian of that place. But it must here be observed, that if the change of declination be considerable during the elapsed time, it must be allowed for, by adding the difference to, or subtracting it from, the second altitude, according as it is increasing or decreasing. Lest that an altitude taken in the forenoon, cannot, by the interposition of the clouds, have a corresponding one in the afternoon, it is adviseable to take several in the forenoon, in order to secure a corresponding one in the afternoon. And if several equal altitudes can be taken on both sides of the meridian, it will be best to find the noons for each pair, and the mean of all the noons thus found, for the true noon.

EXAMPLES.

May 20, 1810, suppose that at 8 h. 40 m. in the forenoon, and 3 h. 16 m. afternoon, by watch, the sun had equal altitudes, and the going of the watch be required?

	H.	M.
Add together	12	0
	8	40
	3	16
	2)23	56
½ gives noon per watch	11	58
True noon - - -	12	0
Watch slow - - -		2

March 17, 1810, suppose at 8 h. 11 m. foren. and at 3 h. 58 m. 32 s. aftern. you have equal altitudes of the sun. Required the going of the watch?

The distance of the time from noon when the first alt. was taken, is 3 h. 49 m., and the daily decrease of decl. at this time is 23′ 41″ = 1421″, which, multiplied by half the number corresponding to 3 h. 49 m. (T. XVIII.) cut off four figures to the right hand, leaves 226″ = 3′ 46″.

Hence the index of the quadrant must be set 3′ 46″ forward on the arch, to correspond with the morn. alt. whence the watch will be found 4′ 46″ too fast.

Here it is supposed that the ship is lying to, or makes no way through the water; but if she is sailing to or from the sun, proper allowance must be made for her running during the elapsed time.

To find the Apparent Time by the Sun's Altitude.

Find the ship's latitude and longitude by account, at the time of observation, by carrying the reckoning forward to that time.

With a quadrant well adjusted, take the altitude of the sun's lower limb.

difference between the semi-diameter and dip of the
d add it to the observed altitude ; the sum will be the
ent altitude.
difference between the sun's refraction and parallax
and subtract it from the apparent altitude ; the re-
l be the true altitude of the sun's centre ; hence the
distance.
ship's longitude into time, and either subtract it from,
, the time per watch, according as it is east or west ;
difference will be the reduced or supposed time at the
servation.
he Nautical Almanack, page 2 of the month, for the
ation on the noon immediately preceding, and the
diately following the reduced time, and find their

f the reduced time take out the number (T. XVIII.)
ng to the hours at top and minutes in the left-hand
th which multiply the diff. of decl. cut off four figures
ght hand of the product, the remainder is the correc-
dded or subtracted according as the decl. is increasing
ng, the result is the decl. or reduced time at the ship ;
ecl. find the polar distance ; then add together the zen.
and polar dist. into one sum.
f this sum subtract the zenith distance, noting the
d remainder ; then add together,
co-secant of the comp. of the lat.

account, the altitude of the sun's lower limb should be found to be 15° 45′, the eye being 18 feet above the surface of the sea, and the true apparent time when the observation was made were required?

Obs. alt. sun's l. l.	15° 45′ 0″	Lat.		39° 54′ 0″
Semi. 15′ 52″ } Diff. + / Dip 4 4 }	0 11 48			90 0 0
		Co. lat.		50 6 0
Ap. alt. sun's l. l.	15 56 48			
Refra. 3′ 17″ } Diff. − / Par. 0 8 }	0 3 9	Sun's decl. May 7th		16 42 23N.
		Ditto 8th		16 58 55N.
Sun's true alt.	15 53 39	Diff. in 24 hours		0 16 32
	90 0 0			
Zenith dist.	74 6 21	16′ 32″ × ,3278 gives	5 25	
		Sun's decl. 7th May	16 42 23	
	H. M. S.			
Time at ship	5 30 32	True dec. for lon. and time	16 47 48	
Long. W. in time +	2 22 0		90 0 0	
Reduced time	7 52 32	Polar dist.	73 12 12	
Co. lat.	50 6 0	Co. sec. } less rad.		0,11511
Polar dist.	73 12 12	Co. sec. } less rad.		0,01893
Zen. dist.	74 6 21			
Sum	2)197 24 33			
½ Sum	98 42 16	Log. sine		9,99496
Zen. dist.	74 6 21			
Remainder	24 35 55	Log. sine		9,61938
		Sum 4 log.		2)19,74838
	41 32 22	log. co-si. ½ Horary angle		9,87419
	2			
				H. M. S.
Hour angle	83 4 44	in time		5 32 19
		Time at ship per watch		5 30 32
		Watch slow		0 1 47

NOTE.—By turning the long. W. into time, (T. XVI.) and adding it to the time at the ship, gives the reduced time, 7 h. 52 m. 32 s. and the difference of declination between the 7th and 8th of May, is 16′ 32″ = 992″, which multiplied by ·32781, a number found in T. XVIII. corresponding to 3 h. 56 m. 16 s. half the reduced time from the product; cut off four figures from the right, the remainder 5′ 25″ is the correction to be added to the dec. for May 7, gives the true declination at the reduced time. Or it may be worked thus:

As 24 h.	=	1440 m.	..	Log. 6,84164 co. ar.
Is to 16′ 32″	=	992″	..	Log. 2,99651
So is 7h. 52m. 32″	=	472m. ,533		Log. 2,67444
To 325″,3	=	5′ 25″,	..	Log. 2,51259

If the reduced time be any even part of 24, as ½, ¼, such aliquot part of the daily diff. of decl. and apply cl. of the last noon; the sum or diff. will be the true uced time.

EXAMPLE II.

that in the forenoon, or A. M. on the 10th of October, 51° 30′ N. and long. 52° E. the alt. of the sun's lower be found as under, the eye being 18 feet above the he sea, and the true apparent time of the day were

H. M.	Alt.		
20 14	12° 28′	Lat. - -	51° 30′ 0″
20 19	13 20		90 0 0
20 30	14 51		
		Co. lat. - -	38 30 0
3)61 3	40 39		
		Sun's dec. Oct. 9th	6 7 2S
20 21	13 33	Ditto 10th	6 29 53S
−3 28			
		Diff. in 24 hours	0 22 51
16 53			
3″ 4 } Diff. +0 11 59		22′ 51″ × ,7042 gives	16 5
		Dec. Oct. 9, at n.	6 7 2

			H. M. S.
Hour angle	121° 34′	in time from last mid.	8 6 16
		Time per watch	8 21 0
		Watch fast	0 14 44

As the time is before noon, the sine of half the sum of the logs. is taken and doubled, which gives the hour angle, reckoned from the last midnight; for there seems to be no necessity for taking the co. sine of half the four logs. unless the observation be made in the afternoon.

Another Method of finding the Apparent Time.

RULE.

When the sun or star's declination and complement of latitude are both north, or both south, their sum *, but if one be north, and the other south, their difference is the meridian altitude.

From the natural sine of the sun or star's meridian altitude, subtract the natural sine of the true altitude.

Then, the sum of the log. co-sec. of the comp. of the lat. the log. sec. of the sun or stars decl. rejecting their indices, and the log. of the difference of the natural sines being found in the column of rising, the hours, minutes, and seconds corresponding to it, will be the true time from the noon when the altitude was taken. We shall work the two foregoing examples by this method.

EXAMPLE I.

Co-latitude	50° 6′ 0″ N.	Log. co-sec.	less rad.	0·11511
Sun's decl.	16 47 48 N.	Log. sec.		0·01893
Meridian alt.	66 53 48	N. sine 91980		
True alt.	15 53 39	N. sine 27386		
	Diff. nat. sines	64606	Its log.	4·81027

In col. of rising gives true time 5 h. 32′ 20″ the app. time P.M. of the given day differing 1″ from the other method. 4·94431

EXAMPLE II.

Co-latitude	38° 30′ 0″ N.	Log. co-sec.	less rad.	0·20585
Sun's decl.	6 23 07 S.	Log. sec.		0·00
Meridian alt.	32 6 53	N. sine 53161		
True alt.	13 41 18	N. sine 23664		
	Diff. nat. sines	29497	Its log.	4·46978

	H. M. S.	
In column of rising gives	3 53 48	4.67833

* If the sum exceeds 90°, subtract it from 180°, and the remainder will be the meridian altitude.

Corresponding to 3h. 53′ 48″, the apparent time from noon, which subtracted from 12, leaves 8 h. 6′ 12″, the apparent time on the morning observation.

A Question for Exercise.

At sea, April 18, 1810, in lat. 45° 37′ N. and lon. 50° 19′ W. from Greenwich, at 4 h. 20′ 30″, P. M. per watch, the alt. of the sun's lower limb was found 25° 20′ 30″, the eye of the observer being 20 feet above the surface of the sea. Required the apparent time of observation?

Answer,

	H.	M.	S.
True time	4	17	40
Ship's time	4	20	30
Watch too fast	0	2	50

To find the Apparent Time by the Altitude of a fixed Star.

Correct the observed altitude for the dip and refraction.

Find the ship's latitude by account, at the time of observation.

Find the star's right ascension and declination in T. XV.

From half the sum of the zenith distance, co-latitude, and polar distance, subtract the zenith distance, noting the half sum and remainder.

Then half the sum of the log. co-sec. of co-latitude; log. co-sec. of polar distance; log. sine of the half sum; and the log. sine of the remainder will be the log. co-sine of half-hour angle, and when doubled, you will have the hour angle. Turn this hour angle into time, and apply it to the star's right ascension by subtracting it when the star is east of the meridian, or adding it when it is west of the meridian, their sum or difference will be the right ascension of the mid-heaven, or meridian.

From the right ascension of the meridian (increased by 24 if necessary) subtract the sun's right ascension the preceding noon at Greenwich, taken from page 2d of the month in the Nautical Almanack, the remainder will be the apparent time at ship nearly.

To this time apply the longitude of the ship from Greenwich turned into time, by adding it when it is west, or subtracting it when it is east, the sum or difference will be the apparent time of the observation nearly by the meridian of Greenwich.

Then the daily variation of the sun's right ascension, multiplied by a number in T. XVIII. corresponding to half the app. time, cut off four figures from the right hand, the remainder is a number of minutes and seconds, which, subtracted from the above time, leaves the correct app. time at ship.

EXAMPLE I.

Suppose on Sept. 7, 1810, in lat. 7° 45′ south, and lon. 30° 18′ east of Greenwich, the altitude of the star Procyon, being then *east of the* meridian, should be 28° 16′, and the eye 18 feet above *the surface* of the sea. Required the true time?

Star's obs. alt.	28° 16′ 0″		90° 0′ 0″
Ref. 1′ 46″ } Sum. Dip. 4 4 }	— 5 50	Star's dec. 1810	5 42 54 N.
		Pol. dist.	95 42 54
Star's true alt.	28 10 10		
90° 0′ 0″	90 0 0		
Lat. 7 45 0	61 49 50 ZD.		
Co.lat. 82° 15′ 0″		Co-sec.	0.00399
Polar dist. 95 42 54		Co-sec.	0.00217
Zen. dist. 61 49 50			
Sum 2)239 47 44			
Half sum 119 53 52		Sine	9.93798
Zen. dist. 61 49 50			
Rem. 58 4 02		Sine	9.92874
		Sum 4 logs.	2)19.87288
½ H <30° 15′ × 2		Co-sine	9.93644
	H. M. S.		H. M. S.
Ho. ang. 60 30 =	4 2	S.'s right asc. Sept. 7,	11 1 38
		Ditto Do. 8,	11 5 14
Star's right ascension	7 29 21		
		Daily difference	0 3 36
Right ascen. of mer.	3 27 21		
Increased by	24 0 0	3.36 × ,6004 gives	2 9
	27 27 21	Time at ship	16 25 43
S.'s right asc. at noon	11 1 38	Cor. subtracted	0 2 9
Time at ship nearly	16 25 43	True time	16 23 34
Ship's long. 30° 18′ E.			12 0 0
in time	2 1 12		
		After midnight	4 23 34
Ti. at Greenw. nearly	14 24 31		

EXAMPLE II.

Suppose, on April 14, 1810, in lat. 48° 56′ N. lon. 66° W. the observed alt. of Aldebaran, when west of the meridian, should be 22° 24′ 29″, the height of the observer's eye 21 feet above the surface of the sea. Required the true apparent time at ship?

Obs. alt. star Aldebar.	22° 24′ 29″		
Refra. 2′ 18″ } Sum - Dip 4 23 }	6 41	Star's dec. 1810	16° 7′ 8″
Star's true Alt.	22 17 48		

		Star's right asc. 1810	H. M. S. 4 25 2
° 0′ 0″		90° 0′ 0′	90° 0′ 0″
56 0	Dec.	16 7 8 Alt.	22 17 48
	Polar dist.	73 52 52 Zen. dist.	67 42 12
4 0	Co-sec. 0.18248		
52 52	Co-sec. 0.01742		
42 12			
39 04			
19 32	Sine 9.99988		
42 12			
37 20	Sine 9.60282	☉'s right asc. 14th	1 28 22
		Ditto 15th	1 32 3
m 4 logs.	2)19.80260		
		Daily difference	0 3 41
11′	Co-sine 9.90130		
2			
	H. M. S.		
22 =	4 57 28	3′ 41″ × .5119 gives	1′ 53″
asc.	4 25 2		
			H. M. S.
f mer.	9 22 30	App. time at ship	7 52 8

fection of instruments for measuring the angular distance, and the insufficient knowledge of the moon's true place, it could not, in his time, be brought to the degree of accuracy to which it is at present arrived.

These difficulties are at length happily surmounted by the invention of Mr. Hadley, in producing his Quadrant and Sextant; and by the ingenuity of Professor Mayer, of Gottingen, who has succeeded in constructing tables agreeing to the moon's motion in every part of her orbit, with surprising exactness.

Finding the difference of longitude between any two places, may be reduced to the problem of finding the difference of time between two places. For, as it is evident that the sun passes over a whole circle of the earth, or 360°, in 24 hours, it follows that the difference of time between the noon of one place and another, will always be the same proportional part of 24 hours, as the difference of their longitude is of 360°. *And the difference between any two given instants of time will be in like proportion.* For if an observer knew that at the same instant that it was two o'clock in the afternoon under the meridian where he was, it was only mid-day at another place, it would be clear he was 30° to the eastward of the given place: since 24h. : 2h. :: 360° : 30°, and the longitude is east, since the time at the place of observation is latest.

To ascertain the difference of longitude between the first meridian and a given place, the angular distance of the moon from the sun or a fixed star is to be observed. For as the distance of the moon from the sun and several fixed stars east and west of her is given in the Nautical Almanack, for every three hours, calculated for the meridian of the Royal Observatory at Greenwich, it is clear that the distance between the same objects being observed at any other place, the time at Greenwich may be deduced therefrom, which, compared with the apparent time, points out the difference of time, and, consequently, the difference of longitude, between the two places.

As the angular distance of objects is conceived to be measured from their centres, the observed distance must be cleared from the effects of parallax and refraction, in order to obtain the true distance. For effecting which purpose, the following methods, by Mr. Lyons and Mr. Witchell, are the most in use.

The necessary Preparations for working a Lunar Observation.

1st. To reduce the time at ship to the time at Greenwich.

Turn the longitude of the ship, carried forward to the time of observation, into time, by allowing 15° for every hour, and add it to the time at ship, if the longitude be west, or subtract it if it be east; the sum or difference will be the supposed time at Greenwich, which call reduced time.

2d. To correct the observed altitude of the sun or star.

Take the sun's semi-diameter from page 2 of the month in the Nautical Almanack, from which subtract the dip of the horizon; the remainder, added to the observed altitude of the lower limb, or the sum subtracted from the observed altitude of the upper limb, will give the true altitude of the sun's centre.

From the sun's refraction take his parallax in altitude, the remainder will be the correction of the sun's altitude. This correction, subtracted from the apparent altitude, will give the true altitude of the sun's centre.

If a star has been observed, from the observed altitude subtract the dip of the horizon, the remainder is the star's apparent altitude, from which take the refraction answering to that altitude, the remainder is the star's true altitude.

3d. To correct the observed altitude of the moon.

Take the moon's semi-diameter and horizontal parallax from page 7 of the month in the Nautical Almanack, for the nearest noon and midnight before and after the reduced time, and find their difference, which multiplied by the number found in Table XVIII. corresponding to the hours and minutes of reduced time, gives a number of seconds, which being added to the moon's semi-diameter at the noon or midnight immediately preceding the reduced time, if it be increasing, but subtracted therefrom, if decreasing, the sum or difference will be the moon's semi-diameter at the time of observation. To the moon's semi-diameter, thus corrected, add the augmentation answering to her observed altitude, the sum will be the moon's true semi-diameter: when the reduced time is any even part of 12 hours, as $\frac{1}{4}$, $\frac{1}{3}$, $\frac{3}{4}$, or $\frac{1}{2}$, such parts of the difference of the semi-diameter and horizontal parallax may be taken and applied as above, without being at the trouble of working by the numbers in Table XVIII.

From the moon's true semi-diameter subtract the dip of the horizon, the remainder, added to the observed altitude of the lower limb, or their sum subtracted from the observed altitude of the upper limb, gives the apparent altitude of her centre.

To obtain the correction of the moon's altitude, proceed as follows:

Having taken out the horizontal parallax at the noon and midnight immediately before and after the reduced time, and having found their difference, as before directed,

Multiply it by the number found in Table XVIII. corresponding to the hours and minutes of reduced time, gives a number of minutes and seconds, which, being added or subtracted from the horizontal parallax, at the noon or midnight immediately preceding the reduced time, according as it is increasing or decreasing; the sum or difference will be the moon's horizontal parallax at the reduced time.

To the prop. log. of the moon's horizontal parallax add the *log. secant* less radius of the moon's apparent altitude, the sum

will be the prop. log. of the moon's parallax in altitude; from which take the refraction, the remainder will be the correction for the moon's altitude.

4th. To correct the observed distance.

To the observed distance of the sun and moon's nearest limbs, add both their semi-diameters, and the sum will be the apparent distance of their centres.

To the observed distance of the moon from a star, add the moon's semi-diameter, if her nearest limb was taken, but subtract it if her farthest limb was taken, the sum or difference will be the apparent distance.

NOTE. There are 12 pages in each month in the Nautical Almanack.

The sun's declination is found in page	II.
The sun's semi-diameter	III.
The moon's semi-dia. and horizont. parallax	VII.
The distance of the moon from the sun, &c.	VIII.IX.X.XI.XII.

Having the apparent Altitude of the Objects, and their apparent Distance, to find their true Distance, by Mr. LYON'S *Method.*

1st. Add together the prop. log. of the correction of the sun or star's altitude, the log. co-sine of the sun or star's apparent altitude, the log. sine of the apparent distance, and the log. co-secant of the moon's apparent altitude; their sum (rejecting 30 in the index) will be the prop. log. of the first arch.

2d. Add together the prop. log. of the correction of the sun or star's altitude, the co-tang. of the sun or star's apparent altitude, the log. tang. of the apparent distance; their sum (rejecting 20 in the index) will be the prop. log. of the second arch.

Take the difference between the first and second arches, which add to the apparent distance, if less than 90°, and the first arch be greater than the second, but if it be less subtract it.

But if the dist. be more than 90°, adding both arches to the apparent dist. will give the dist. corrected for the refraction of sun or star.

3d. Add together the prop. log. of the correction of the moon's altitude, the log. co-sine of the moon's apparent altitude, the log. sine of the dist. corrected for the sun or star's refraction, the log. co-sec. of the sun or star's true altitude; their sum (rejecting 30 in the index) will be the prop. log. of the third arch.

4th. Add together the prop. log. of the correction of the moon's apparent altitude, the log. co-tang. of the moon's apparent altitude, the log. tang. of the dist. corrected for the sun or star's refraction; their sum (rejecting 20 in the index) will be the prop. log. of the fourth arch.

Take the difference between the third and fourth arches, and subtract it from the distance corrected for the sun or star's refraction,

if less than 90, and the third arch be greater than the fourth; or, add it to the distance corrected, if the fourth arch be greater than the third; but, if the distance be more than 90°, the sum of both arches must be subtracted from it; and the sum or difference will be the distance corrected for the sun or star's refraction, and the principal effect of the moon's parallax.

In Table XXVI. look for this last corrected distance in the top column, and the correction of the moon's altitude in the left-hand side column; take out the number of seconds that stand under the former and opposite to the latter.

Look again in the same table for the corrected distance in the top column, and the principal effect of the moon's parallax in the left-hand side column, and take out the number of seconds that stand under the former and opposite the latter. The difference between these two numbers must be added to the corrected distance if less than 90°, but subtracted from it if more than 90°;

The sum, or difference, will be the true distance.

Having the true Distance and Time, to determine the Longitude.

IN the Nautical Almanack, among the distances of the objects, look for the computed distance between the moon and the other object observed on the given day; if it be found there, the time at Greenwich will be at the top of the column, but if it falls between two distances, as it generally will, take the difference between the distances that stand immediately before and after the computed distance, and also the difference between the distance standing before it and the computed distance.

Then take the proportional logarithm of the first difference which is the difference in three hours, and the proportional logarithm of the second difference, which is the difference between the computed distance and the distance before it.

The difference between these two logarithms will be the proportional logarithm of a number of hours, minutes, and seconds, which being added to the time standing over the first distance in the Nautical Almanack, will give the true time at Greenwich.

The difference between Greenwich-time and that at the ship turned into longitude, will be the longitude in, at the time the observations were made, which will be east if the time at the ship be greater than that at Greenwich, but if it be less, the longitude will be west.

Or the proportional part of time may be found by saying;

As the first difference : is to 3 hours :: so is the second difference : to a proportional part of time, which being added as above directed will give the true time at Greenwich.

Note. In working the following examples, it will save some time, if all the logarithmic sines, tangents, secants, and proportional logarithms, which fall at the same opening

of the book, be taken out at the same time, both in the first and second part of the operation.

Thus, the co-sine and co-tangent of the star's apparent altitude, and co-secant of its altitude may all be taken out at the same time, and written down in different parts of the paper (or in a formula) and so may the co-sine, co-tangent, and co-secant of the moon's apparent altitude, the sine and tangent of the apparent distance and the sine and tangent of the distance corrected, for the refraction of the sun or star.

EXAMPLE I.

Suppose, on the 26th day of September 1811 in longitude 13° 30′ west of Greenwich by account at 6h. 10m. P. M. by a watch well regulated, the distance of the sun and moon's nearest limbs were observed to be 104° 0′ 11″, when the moon's altitude of her lower limb was 43° 20′ 30″, the altitude of the sun's lower limb 12° 39′ 18″, the eye of the observer 20 feet above the surface of the sea. Required the true longitude ?

	H. M.		M. S.		M. S.	
Time by watch	6 10	☽'s semi-dia. n.	15 58	☽'s hor.par. at noon	58 34	
Long. in time +	54	Do. midnight	16 4	Do. midnight	58 59	
Red. time	7 4	Diff. in 12 hours +	6	Diff. in 12 hours +	25	
		6×.5888 gives +	4	25×.5888 gives +	15	
☉'s obs. alt. 12° 39′ 18″		☽'s semi-dia. noon	15 58	☽'s par. at noon	58 34	
Se. dia. 1559 / Dip 4 17	+11 42		16 2	☽'s par. at red. ti.	58 49	P. L. 4858
		Augmentation	11	☽'s ap. alt.	43 32 26	sec. 0.1398
App. alt.	12 51 0	☽'s semi-dia.	16 13	☽'s par. in alt.	42 37	P. 0.6329
☉'s ref. 46 / ☉'s par. 9	− 8 57	Dip	4 17	Refraction −	1 28	
☉'s true alt.	12 47 3		11 56	☽'s correction	41 9	
		Obs. alt	43 20 30	Dist. of ☉ and ☽'s nearest limbs	104° 0′ 11″	
				and ☽'s semi-dia. 1559+1613=	32 12	
		☽'s ap. alt.	43 32 26			
				☽'s App. dist.	104 32 23	

To find the Distance by Mr. Lyon's *Method.*

	D. M. S.						
Cor. for ☉'s ap. alt.	3 57	P.L.	1 6587			P. L.	1 6587
☉'s ap. alt.	12 51 0	Co-sine	9 9890			Co-tang.	0 6418
App. Dist.	104 32 23	Sine	9 9858			Tang.	0 5861
☽'s ap. alt.	43 32 26	Co-sec.	0 1619	First arc	2′ 53″		
				Second arc	14	P. L.	2 8366
First arc	2 53	P. L.	1 7954				
	Cor. for ☉'s refrac.				3 7		
	App. dist.				104 32 23		
	Dist. correc. for ☉'s refrac.				104 35 30		
Cor. for ☽'s ap. alt.	0° 41′ 9″	P. L.	0 6409			P. L.	0 6409
☽'s ap. alt.	43 32 26	Co-sine	9 8602			Co-tang.	0 0219
Correc. dist.	104 35 30	Sine	9 9858			Tang.	0 5845
☉'s alt.	12 47 3	Co-sec.	0 6950				
Third arc	11 51	P. L.	1 1819	Fourth arc	10′ 11″	P. L.	1 2473
				Third arc	11 51		
	Principal effects of the ☽'s par.				22 2		
	Dist. correc. for ☉'s refraction				104 35 30		

's ref. and prin. ef. of ☽'s par.		104° 18′ 28″		
XXVI. 16 } 19 } Difference		3		
e Longitude. True distance		104 18 25		
Dist. at 6 hours	103° 46′ 27	103 46 27		
Do. at 9 hours	105 22 59			
		26 58	P. L.	8244
	1 36 32		P. L.	2706
Time over first dist.		6		
		50 17	P. L.	5538
tude is / time / t. True time at Greenwich		6 50 17		
Time at ship		6 10		
Long. in time		40 17	=	10° 4′ 15″W.

EXAMPLE II.

on the 14th of July 1811, in longitude 23° east of , at 5 h. 36 m. P. M. by a watch well regulated, the he moon's nearest limb to the sun was 68° 10′ 24″, when of the sun's lower limb was 31° 48′ 30″, the alt. of the r limb 23° 48′ 14″, the height of the eye of the obser- above the sea, the true longitude is required?

H. M.		M. S.		M. S.
5 36	☽'s semi-dia. at noon	15 45	hor. par. noon	57 47
1 32	Do. at midnight	15 40	Do. midnight	57 28
4 4	diff. in 12 hours	5	Diff. in 12 hours	19

	°	′	″							
Cor. for ☽'s app. alt.		50	34	P. L.	0 5514				P. L.	0 5514
☽'s app. alt.	24	0	0	Co-sine	9 9607				Co-tang.	0 3514
Corrected distance	68	42	23	Sine	9 9693				Tang.	0 4092
☉'s true altitude	81	58	49	Co-sec.	0 2760					
						4th arc	8	59	P. L.	1 3120
Third arc		31	28	P. L.	0 7574	3d arc	31	28		

	°	′	″
Principal effects of ☽'s par.	—	22	29
Dist. corrected for ☉'s refraction	68	42	23
	68	19	54
First correction in Table XXVI. 9, Second ditto ditto 2 } difference		+	7
True dist.	68	20	1

To determine the longitude.

True distance	-	-	-	68 20 1			
By Nau. Alm. the dist. at three hours	68° 50′ 10″			68 50 10			
Ditto at six hours	67 17 33						
			diff.	30 9	P. L.	7760	
	diff. 1 32 37	-	-	-	P. L.	2686	
				H. M. S.			
				3 58 36	P. L.	4874	
		time at ship		5 36			
		diff. long. in time		1 37 24	24° 21′ E.		

H.	M.	S.	
1	37	24	
×		5	
8	7	0	
×	3		
24	21		Long. east.

EXAMPLE III.

Suppose that about ¾ past four P. M. on the 3d Dec. 1811, in lat. 54° 25′ S. long. by account 10° E. six observations were made, the mean of which were taken at 4 hs. 50 m. and the altitude was 27° 42′ 35″, the error of the instrument 24″ to be added, the eye of the observer 21 feet above the surface of the sea, required the true time.

	H.	M.				°	′	″		°	′	″		
Mean time at ship		4 50	obs. alt. ☉ L. L.			27	42	35	zen. dist.	62	6	48		
Long. 10° E.	—	40	error of quad.			+		24	co-lat.	35	35	0	co-sec.	0.23516
									pol. dist.	67	56	1	co-sec.	0.03304
Ti. at Greenwich		4 10	☉'s se. dia.	16 16	}	27	42	59						
			Dip	4 23	}	+	11	53		165	37	49		
☉'s dec. 3d Dec.	22	2 20	S.											
Ditto 4th.	22	10 52	ref.	1 48	}	27	54	52		82	48	54	Sine	9.99658
			☉'s par.	8	}	—	1	40		62	6	48		
Diff. in 24 hours	+	8 32												
8′32″ × .1736 gives		1 39	true alt.			27	53	12		20	42	6	Sine	9.54839
☉'s dec. 3 Dec.	22	2 20				90								
														19.81317
☉'s dec.	22	3 59	zen. dist.			62	6	48						
	90		latitude			54	25			36	15		co-sine	9.90658
						90					2			
Pol. dist.	67	56 1											H. M.	
			Co-lat.			35	35			72	30		in time	4 50

On the same evening the following observations were made of the distance of the star Regulus from the moon's farthest limb, lon. by account as before, and the error of the instruments by which the moon's altitude and distance were taken was 7′ 30″ and 25″ to be added; the true longitude is required.

	Times.	Alt. of Regulus.	Alt of ☽'s Low. Limb.	Dist. of ☽ and ✳
	H. M. S.	° ′ ″	° ′ ″	° ′ ″
	10 44 37	19 50 30	19 54 43	31 30 43
	10 27 29	20 2 0	19 9 43	31 30 30
	10 30 4	20 15 0	19 28 13	31 33 0
	10 32 8	20 29 0	19 48 43	31 34 0
	10 34 16	20 40 0	19 57 43	31 35 45
5	52 38 34	101 16 30	97 14 5	157 44 58
	10 33 43	20 15 18	19 29 49 + 7 30	31 32 59 + 25
Mean	10 33 43	20 15 18	19 34 19	31 33 24

	H. M. S.				
Time at ship	10 33 43	Obs. dist. of ☽ and ✳	31 33 24	✳'s obs. alt.	20 15 18
Long. in time	40	☽'s semi-dia.	15 21	Dip	— 4 23
Reduced time	9 53 43	Ap.dist.of ⊙ & ☽ cent.	31 18 3	✳'s app. alt.	20 10 55
☽'s se. dia. noon	15 21	☽'s hor. par. noon	56 19	Refraction	— 2 34
Ditto midnight	15 15	Ditto midnight	55 58		
				✳'s true alt.	20 8 21
Diff. in 12 hours	— 6	Diff. in 12 hours	— 21	P. L. 0 5062	
6 × .8250 gives	5	21 × .8250 gives	— 17	Sec. 0 0264	
☽'s sem-dia.	15 21	☽'s hor. par. noon	56 19		
				P. L. 0 5332	
☽'s semi-dia.	15 16		56 2		
Augmentation	5	☽'s app. alt.	19 45 17		
☽'s semi-dia.	15 21	Hor. par. red. ti.	52 44		
Dip	4 23	Refraction	— 2 37		
	10 58	☽'s correction	50 7		

Here I have given one method of finding the longitude, illustrated by a sufficient number of examples, all of which are reduced to the year 1811, in order that the reader, or teacher, may have sufficient time to furnish himself with a N. A. for that year, which is now printed. But as many would wish to have some other method of reducing the distance, that, by comparing them together, they may not only have the advantage of proving their calculations, but also of making choice of which they prefer to work by; the second method I shall present the reader with, is chiefly deduced from that invented by Mr. Witchell, late master of the Royal Academy at Portsmouth, as it is short, and requires but four places of figures in the logarithms, besides the index; the preparations in both methods being exactly the same.

RULE.

First. Add the sun or star's and moon's apparent altitudes together, take half the sum; subtract the less from the greater, and half the difference; then add together the co-tang. of half the sum, the tang. of half the difference, and the co-tang. of half the apparent distance; their sum (rejecting 20 in the index) will be the log. tang. of an angle, which call A.

Secondly. When the sun or star's altitude is greater than the moon's, take the difference between angle A, and half the apparent distance; but if less, take their sum. Then add together the co-tang. of this sum or difference, the co-tang. of sun or star's apparent altitude, and the prop. log. of the correction of the sun or star's altitude; their sum (rejecting 20 in the index) will be the prop. log. of the first correction.

Thirdly. If the sum of angle A and half the distance was taken in the last article, take now their difference, but if their difference, now take their sum; then add together the co-tang. of the sum, or difference, the co-tang. of the moon's apparent altitude, and the prop. log. of the correction of the moon's apparent altitude; their sum (rejecting 20 in the index) will be the proportional logarithm of the second correction.

Fourthly. When the angle A is less than half the apparent distance, the first correction must be added to, and the second subtracted from, the apparent distance; but when the angle A is greatest, their sum must be added to the apparent distance, when the sun or star's altitude is less than the moon's; but when the moon's altitude is least, their sum must be subtracted to give the corrected distance.

Fifthly. In Table XXVI. look for the corrected dist. in the top column, and the correction of moon's alt. in the left-hand side column; take out the number of seconds that stand under the former and opposite the latter. Look again in the same table for the corrected distance in top column, and the second correction in the left-hand side column; take out the number of seconds that

he former and opposite to the latter, the difference be-
two numbers will be the third correction, which must
he corrected distance, if less than 90°; but subtracted
ore than 90°; the sum, or difference, will be the true

te this last method of reducing the apparent distance
distance, I shall take the apparent altitudes and dis-
y stand in the first examples, worked by the former

EXAMPLE I. See Example I. p. 231.

apparent distance of the sun and moon's centres, 104°
un's apparent altitude 12° 51', that of the moon 43° 32'
izontal parallax at reduced time 58' 49". Required
ance of their centres by Mr. Witchell's method.

I. S.				
6	☽'s hor. par. at red. ti.	58' 49"	P. L.	0 4858
9	☽'s ap. alt.	43 32 26	Sec.	0 1398
57	☽'s par. in alt.	42 37	P. L.	0 6256
	Refraction	1 28		
	☽'s correction	41 9		
12° 51 0				
43 32 26				
56 23 26	Half sum 28° 11' 43"		Co-tang.	10 2708

☉'s ap. alt. 32° 0' 12"
☽'s ap. alt. 24 0 0

Sum	56 0 12	Half sum	28° 0 6	Co-tang.	0 2743
Diff.	8 0 12	Half diff.	4 0 6	Tang.	8 8554
Ap. dist.	68 42 0	Half dist.	34 21 0	Co-tang.	0 1653
1st cor.	+ 22				
		Arc A	11 9 30	Tang.	9 2950
	68 42 22				
2d cor.	22 55	Diff.	23 11 30	Co-tang.	0 3681
		☉'s ap. alt.	32 0 12	Co-tang.	0 2042
	68 19 27	☉'s cor.	1 23	P. L.	2 1143
3d cor.	8				
		1st cor.	22	P. L.	2 6866
True dist.	68 19 35				
		Sum	45 30 30	Co-tang.	9 9923
		☽'s ap. alt.	24 0 0	Co-tang.	0 3514
		☽'s cor.	50 34	P. L.	0 5514
		2d correc.	22 55	P. L.	0 8951

EXAMPLE III. See Example p. 233.

Given, the apparent distance of the moon's centre from the star gulus 31° 18' 13', the apparent altitude of the star 20° 10' 55", t of the moon 19° 45' 17", the star's correction 2' 34", that of moon's correction 50' 7". What is the true distance of their ıtres by Mr. Witchell's method?

*'s ap. alt. 20° 10' 55"
☽'s ap. alt. 19 45 17

Sum	39 56 12	Half sum	19° 53' 6"	Co-tang.	0 4397
Diff.	25 38	Half diff.	12 49	Tang.	7 5715
Ap. dist.	31 18 13	Half dist.	15 39 6	Co-tang.	0 5525
1st cor.	+ 14				
		Arch A	2 5 50	Tang.	8 5637
	31 18 27				
2d cor.	— 5 46	Diff.	13 33 16	Co-tang.	0 6178
		*'s ap. alt.	20 10 55	Co-tang.	0 4346
	31 12 41	*'s cor.	2 34	P. L.	1 8459
3d cor.	+ 35				
		1st cor.	14	P. L.	2 8983
True dist.	31 13 16				
		Sum	17 44 56	Co-tang.	0 4947
		☽'s ap. alt.	19 45 17	Co-tang.	0 4449
		☽'s correc.	50 7	P. L.	0 5553
		2d correc.	5 46	P. L.	1 4949

Another Method.

First. From half the sum of the apparent altitudes of the sun and moon, or moon and star, and the apparent distance, subtract the sun or star's apparent altitude; the difference call the first remainder, the moon's apparent altitude taken from the half sum leaves the second remainder.

Secondly. To the log. sine of thirty degrees add the log. sine of the apparent distance, the log. co-sine of the moon's apparent altitude, the log. secant of the half sum, the log. co-secant of the first remainder, and the prop. log. of the moon's correction; reject the tens in the index, the remainder will be the prop. log. of the first correction.

Thirdly. To the log. sine of thirty degrees add the log. sine of the apparent distance, the log. co-sine of the sun or star's apparent altitude, the log. secant of the half sum, the log. co-secant of the second remainder, and the prop. log. of the sun or star's correction; reject the tens in the index, the remainder will be the prop. log. of the second correction.

The difference between the correction of the moon's altitude, and the first correction, call the difference of corrections.

Enter Table XXVI. with the apparent distance at the top, and the moon's correction in the left-hand side column, the corresponding number will be the third correction; in the same column, and corresponding to the difference of corrections, you may find the fourth correction.

Fifthly. Subtract the moon's, the second and fourth corrections from the apparent distance, to the remainder add the sun or star's, the first and third correction; the sum will be the true distance.

EXAMPLE I. See Example p. 231.

Given, the apparent distance of the sun and moon's centres 104° 32′ 23″, the sun's apparent altitude 12° 51′, that of the moon 43° 32′, 26″, the sun's correction 3′ 57″, and the moon's correction 40′ 55″. Required the true distance.

	30° 0′ 0″	Sine	9 6990		9 6990	☽'s cor.	41′ 9″
Ap. dist.	104 32 23	Sine	9 9859		9 9859	2d cor.	50
☽'s ap. alt.	43 32 26	Co-sine	9 8602			4th cor.	19
☉'s ap. alt.	12 51 0	Co-sine			9 9890		
							42 18
Sum	160 55 49						104 32 23
Half Sum	80 27 54	Sec.	0 7808		0 7808		
1st rem.	67 36 54	Co-sec.	0 0340				103 50 5
2d rem.	36 55 28	Co-sec.			0 2213	☉'s cor.	3 57
☉'s cor.	3 57	P. L.			1 6587	1st cor.	17 58
☽'s cor.	41 9	P. L.	0 6409	2d Cor.		3d cor.	16
				50″ P.L.	2 3347		
1st cor.	17 58	P. L.	1 0008			True dist.	104 12 16
Dif. cor.	23 11						

EXAMPLE II. See Example p. 2.

Given, the apparent distance of the sun and moon's centres 68° 42′ 0″, the sun's apparent altitude 32° 0′ 12″, apparent altitude of the moon 24° 0′ 0″, the sun's correction 1′ 23″, the moon's 50′ 34″. Required the true distance.

	30° 0′ 0″	Sine	9 6990		9 6990	☽'s cor.	50′ 34″
Ap. dist.	68 42 0	Sine	9 9693		9 9693	2d cor.	1 0
☽'s ap. alt.	24 0 0	Co-sine	9 9607			4th cor.	1
☉'s ap. alt.	32 0 12	Co-sine			9 9284		
							— 51 35
Sum	124 42 12						68 42 0
Half sum	62 21 6	Sec.	0 3335		0 3335		
1st rem.	30 20 54	Co-sec.	0 2965				67 50 25
2d rem.	38 21 6	Co-sec.			0 2073	☉'s cor.	1 23
☉'s cor.	1 23	P. L.		2d cor.	2 1143	1st cor.	27 51
☽'s cor.	50 34	P. L.	0 5514			3d cor.	8
				1′0″P.L.	2 2518		
1st cor.	27 51	P. L.	0 8104			True dist.	68 19 47
Diff. of cor.	22 43						

EXAMPLE III. See Example p. 233.

Given, the apparent distance of the moon's centre from the star Regulus 31° 18′ 30″, the apparent altitude of the moon 19° 45′ 17″, the apparent altitude of the star 20° 10′ 55″, the star's correction 2′ 34″, the moon's correction 50′ 7″. What is the true distance of their centres?

	30° 0′ 0″	Sine	9 6990		9 6990	☽'s cor.	50′ 7″
Ap. dist.	31 18 13	Sine	9 7156		9 7156	2d cor.	2 20
☽'s ap. alt.	19 45 17	Co-sine	9 9736			4th cor.	1
*'s ap. alt.	20 10 55	Co-sine			9 9725		
							52 28
Sum	71 14 25						31 18 3
Half sum	35 37 12	Secant	0 0899		0 0899		
1st diff.	15 26 17	Co-sec.	0 5748				30 25 35
2d diff.	15 51 55	Co-sec.			0 5683	*'s cor.	2 34
*'s cor.	2 34	P. L.			1 8459	1st cor.	44 22
☽'s cor.	50 7	P. L.	0 5553				
				2′ 20″	1 8867	3d cor.	36
1st cor.	44 22	P. L.	0 6082				
Diff. of cor.	5 45					True dist.	31 13 7

The difference in this last method is, that there is no variety of cases.

Questions for Exercise.

Suppose, on the 23d of May 1805, in longitude 9° west of Greenwich, by account at 3 h. 41 m. 15 s. P. M. by a watch well regulated, the distance of the sun and moon's nearest limbs should

d to be 67° 5′ 36″, at the same time the altitude of the r limb should be 31° 48′ 15″, the moon's 23° 48′ 15″, the observer being 18 feet above the surface of the sea. the true longitude of the place.

er. 11° 20 15″ west.

, at sea in longitude of 10° west by account, on June the the mean of five observations were taken; viz. at 3 h. P.M. the distance of the sun and moon's nearest limbs 18 m. 12 s. the error of the sextant 2 m. 37 s.—the al- e moon's upper limb 20° 4′ 6″, the error of the quadrant altitude of the sun's lower limb 45° 22′ 3″, the error of nent 48 s.—the eye being 21 feet above the sea. Re- true longitude.

er. 5° 59′ west.

, on the 1st of January 1806, in longitude 8° east of by account, at 5 h. 56 m. A.M. per watch well regu- distance of the moon's farthest limb from the star Pollux 62° 52′ 28″, the altitude of the moon's lower limb being and the star's altitude 29° 51′ 39″, the eye of the ob- ng 18 feet above the surface of the sea, and the true lon- uld be required.

er. 7° 36′ 30″ east.

-In vessels which afford only one observer, it will be ciently exact for practice to have a quadrant at hand, in ake the altitudes of the objects immediately after the observed, as the difference of altitudes which take place

from the column of rising take out the logarithm corresponding to it.

To this logarithm add the log. co-sine of the latitude, and the log. co-sine of the sun's declination.

Their sum, rejecting 20 in the index, will be the logarithm of a natural number, which, being subtracted from the natural sine of the sun's meridian altitude, will leave the natural sine of his true altitude at the given time.

EXAMPLE I.

Required the true altitude of the sun's centre, in latitude 49° 57′ N. when its declination is 19° 26′, at 6 h. 56 m. 30 s. in the morning.

	H. M. S.		
	12 0 0		
pp. time	6 56 30		
ime from noon	5 3 30	Its log. in col. of rising	4.87850
atitude	49 57 0 N.	Its log. co-sine	9.80852
ecl. at that time	19 26 0 N.	Its log. co-sine	9.97453
-lat.	40 3 0	Rej. 20 N.N. 45872 = log. =	4.66155
er. alt.	59 29 0	Nat. sine	86148
		Nat. sine true alt.	40276=23° 45′.

EXAMPLE II.

What will be the true altitude of the sun's centre at London, hen its declination is 20° 49′ S. at 3 h. 21 m. 30s. apparent time the afternoon?

	H. M. S.		
p. time from N.	3 21 30	Its log. in col. of rising	4.55900
itude	51°32′ N.	Log. co-sine	9.79383
l. at that time	20 49 S.	Log. co-sine	9.97068
lat.	38 28 N.	Nat. num. 21062=log=	4.32351
. alt.	17 39	Nat. sine	30320
. sine true alt.	5 19	Nat. sine	09258

CASE II.

The apparent Time, the Latitude and Longitude given, to find the Altitude of any of the known fixed Stars.

RULE.

Turn the longitude into time, and add it to or subtract it from the time at the ship, according as it is east or west, the sum or difference will be the time at Greenwich.

Take the sun's right ascension from the Nautical Almanack, proportion it to the time at Greenwich, and add it to the apparent time at the ship, which will give the right ascension of the meridian, or mid-heaven.

Find the star's right ascension and declination in Table XX. and take the difference between its right ascension and the right ascension of the meridian, which will be the distance of the star from the meridian.

Having the star's distance from the meridian, with its declination and the ship's latitude, the true altitude is found in the same manner as has been shown in the last examples of finding the true altitude of the sun.

EXAMPLE II.

What will be the true altitude of Aldebaran, April 11, 1811, at 5 h. 56 m. 20s. P.M. apparent time, in latitude 55° 58′ N. and long. 3° 6′ W.?

			H. M. S.		
App. time at ship - - -			5 56′ 20		
Long. 3° 6′ W. in time +			12 24		
Time at Greenwich -			6 8 44		
Sun's right ascen. Apr. 11, at n. by N.A. -			1 16 27		
Prop. part, for 6h. 8m. 44s. +			10		
Sun's right asc. at time of obs.			1 16 37		
App. time at ship - -			5 56 20		
Right asc. of the meridian			7 12 57		
Star's right ascension -			4 25 5		
Star's dist. from meridian			2 47 52	col. of log. ris.	4 40903
Lat. -	55° 58′ 0″ N.			L. co-sine	9 74794
Star's dec.	16 7 16 N.			L. co-sine	9 98258
Co-lat.	34 2 0	N.	13790	Log.	4 13955
Mer. alt.	50 9 16	N. sine	76777		
True alt.	39 2 26	N. sine	62987		

CASE III.

The apparent Time, the Latitude and Longitude of the Ship being given, to find the true Altitude of the Moon's Centre.

RULE.

Turn the longitude into time, and if it be west add it to, but if it be east subtract it from, the apparent time at the ship, and it will give the time at Greenwich.

Take the sun's right ascen. out of the N. A. and proportion it to Greenwich time, which being added to the time at the ship, the sum will be the right ascension of the meridian or mid-heaven.

Take out of the N. A. the moon's right ascension and declination, and proportion them to the time at Greenwich. Turn the moon's right ascension into time, and take the difference between it and the right ascension of the mid-heaven, which will be the distance in time of the moon from the meridian.

Having the ship's lat. together with the moon's declin. and dist. from the meridian, the true altitude is found, in the same manner as has been shown in finding the true altitude of the sun and star.

EXAMPLE.

What will be the moon's true altitude April 22, 1811, at 6h. 20m. P.M. in lat. 42° 34′ S. and long. 84° 30′ west of Greenwich by account?

	H. M.			
App. time at ship	6 20	Moon's dec. at noon	7° 13	
Long. 84° 30′ in ti.	+ 5 38	2° 10′ by .9973 gives	+ 2 1	
Red. time	11 58	Moon's dec. at red. ti.	9 14	
☉'s ri. asc. 22 ap.	1 57 7	☽'s ri. asc. at noon	23 45	
3′ 44″ × .4986 give	+ 1 50	6° 54′ × .9973, gives	+ 6 53	
Ri. asc. at red. time	1 58 57		30 38	
App. time at ship	6 20	In time	= 2h. 2m. 32″	
AR of the meridian	8 18 57			
☽'s right ascension	2 2 32			
☽'s dist. from mer.	6 16 25	Log. in col. of rising		4 03040
Ship's latitude	42 34 0	Log. co sine		9 86717
☽'s dec.	9 14 0	Log. cosine		9 99432
Comp. lat.	47 26 0			
		Nat. num.	2450	3 89189
Mer. alt.	38 12 0	Nat. sine	61841	
True altitude	36 26 5	N. Sine	59391	

In the last example, proportional parts are taken in finding the right ascension, declination, and log. rising.

By the three last cases the true altitudes of the objects are found, therefore if the apparent altitudes be wanted, the difference between the sun's parallax and refraction must be added to the sun's true altitude, the refraction must be added to the true altitude of a star, and the difference between the moon's refraction and parallax in altitude must be subtracted from the true altitude of the moon thus found, to obtain the respective apparent altitudes of their centres.

To find the Longitude by the Eclipses of Jupiter's Satellites.

On the day preceding the evening on which it is proposed to observe an eclipse, look for the time when it will happen at Greenwich, in page 3d of the month in the Ephemeris. Find the diff. of longitude either by a good map, sea chart, or dead reckoning.

Let the watch be regulated by the sun with all possible exactness to the apparent time. Turn the difference of longitude into time, and add it to, or subtract it from, the apparent time, according as it is east or west of Greenwich, the sum or difference will be nearly the time when the eclipse is to be looked for in that place. But as the longitude is uncertain, it will be proper to begin 20 or 30 minutes before.

Observe the hours, minutes and seconds of the beginning of the eclipse, called immersion, that is, the very instant that the satellite appears to enter into the shadow of Jupiter; or the emersion, that is, when it appears to come out of the same. The difference of time between the observed immersion, or emersion, and that set down in the Nautical Almanack, being turned into degrees, will give the difference of longitude between Greenwich and the place of observation.

These observations made on the first satellite, or that which moves nearest to the body of Jupiter, are the most proper for determining the longitude; and here it may be observed, that its emersions are not visible from the time of Jupiter's conjunction with the sun to the time of his opposition to the sun, and that its immersions are not visible from the time of the planet's opposition to the sun, to the time of its conjunction.

The configurations, or the positions in which Jupiter's satellites appear at Greenwich, are laid down every night when visible, in page the 12th of the month in the Ephemeris.

EXAMPLE.

Suppose on March 19, 1811, in long. 16° 43′ 49″ E. by account, an emersion of Jupiter's first satellite was observed at 11h. 3m. apparent time, required the longitude.

	H.	M.	S.
At Greenwich that day the emersion began at	9	56	28
Observed emersion at ship	11	3	0
Diff. in time	1	6	32

turned into longitude gives $16^{\circ} 38' 0''$ E, because the time at Greenwich is less than at the place of observation, the error in the longitude is 5 miles and 49 seconds.

As these eclipses happen almost daily, they afford the most ready means of determining the longitude of places on land, and then the longitudes of sea-coasts might be better ascertained than they are at present; they might also be applied at sea, could they be observed with sufficient accuracy in a ship under sail, which can hardly be done, since the least motion of a telescope that magnifies sufficiently to make these observations, would throw the objects out of the field of view.

The eclipses of Jupiter's satellites may be well observed by one of Dollond's new achromatic telescopes of three feet in length, or by a reflecting telescope of 18 or 20 inches focal length.

To find the Longitude by the Eclipses of the Moon.

This is performed by comparing the times of the beginning or ending, as also the times when any number of digits are eclipsed, or when the earth's shadow begins to touch or leave any remarkable spot on the moon's face.

Then will the difference of time between the like observations made at different places, turned into degrees, be their difference of longitude.

But these eclipses happen too seldom to be of any general use at sea.

To find the Longitude by a Chronometer or Time-keeper.

When it is intended to make use of a time-keeper, it is requisite to examine its rate of going before you leave the land, and adjust it to the meridian of the place from which you reckon your longitude. To do this, you must ascertain the apparent time by the sun's altitude (or by some other method) and apply to it the equation of time, taken from page 2 of the Nautical Almanack, according to its title of *add* or *subtract*; the sum or difference will give the mean time of observation: this, compared with the watch, will show how much it is too fast or too slow, and by observing this difference for several days sucessively, you will ascertain its rate of going: if you find it gain or lose a few seconds per day, you must make that allowance on all future observations at sea. Instead of comparing the time shown by the chronometer, to the mean time at the place of observation found as above, you may compare it with that mean time reduced to Greenwich time, by adding to that mean time the difference of longitude between Greenwich and the place of observation, when it is to the westward of Greenwich, but subtracting it when to the eastward; and by this means you will find how much your chronometer differs from Greenwich time. Having thus regulated your time-keeper, the longitude at sea is readily found by it, as will evidently appear by the following examples:

EXAMPLE I.

Suppose that on Dec. 12, 1811, the apparent time was found by an altitude of the sun to be 1h. 5m. 9s. P. M. when, by a time-keeper well regulated to mean Greenwich time, it was 4h. 3m. 0s. P. M. Required the longitude.

		H.	M.	S.
Apparent time	- -	1	5	9
Equation of time	- - +	0	6	16
	Mean time	1	11	25
Time per watch	- -	4	3	0
		2	51	35

equal to $42^{\circ}\ 53'\ 45''$ of west longitude, because the time at Greenwich is greater than the time at ship.

EXAMPLE II.

Suppose that on Sept. 13, 1811, the apparent time was found by an altitude of the sun to be 4h. 3m. 6s. P. M. when the time per chronometer is 2h. P. M. the watch being too slow for mean Greenwich time 11m. 9s. Required the longitude.

	H.	M.	S.			H.	M.	S.
Apparent time	4	3	6	P. M.	Time per watch	2	0	0
Equat. of time	−0	3	56		Watch error	+0	11	9
Mean time	3	59	10	P. M.	Time at Greenw.	2	11	9 P.M.
Ti. at Greenw.	2	11	9					
Diff. of time	1	48	1					

equal to $27^{\circ}\ 0'\ 15''$ east longitude.

OBLIQUE TRIGONOMETRY.

AXIOM II.

In all plane triangles the sides are in direct proportion to the sines of their opposite angles.

To find a Side.

As the sine of an angle
Is to its opposite side,
So is the sine of either of the other angles in the same triangle
To the side opposite thereto.

To find an Angle.

As any side given
Is to the sine of its opposite angle,
So is either of the other sides in the same triangle
To the sine of its opposite angle.

CASE I.

Two angles and one side given, to find either of the legs.

The angle BDC=100° and angle DCB=54°,

And the leg BD=220° are given to find the sides.

∠ BDC	100°	00′
∠ DCB	54	00
	154	00
	180	00
∠CBD	26	00

CONSTRUCTION.

Draw an indefinite line GE, add the two angles D and C together, and subtracting their sum from 180° leaves the remaining angle B 26°: on the line GE, on any point as at B, describe the angle B 26, and on BH set off BD 220. On D make the angle BDC 100°, then DC will intersect the line GE in the point C, which completes the triangle, and BC will measure on the same scale from which BD was laid down 268 nearly, and DC 119 also on the same scale.

To find CB.		To find DC.	
As the sine of the ang. C 54° co. ar.	0,09204	As sine ang. C 54° co. ar.	0,09204
Is to the side BD 220	2,34242	Is to the side BD 220	2,34242
So is supt. si. of ang. BDC 80°	9,99335	So is sine ang. B 26°	9,64184
To the side BC 267.8	2,42781	To side DC 119.2	2,07630

By Gunter.

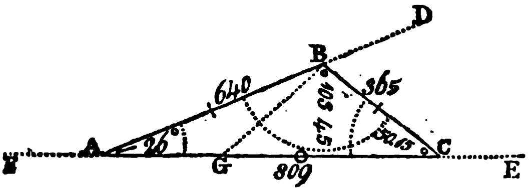
1st. The extent from 80° to 54°, on the line of sines, will reach from 220 to 267, on the line of numbers for BC.

2d. The extent from 54° to 26°, on the line of sines, will reach from 220 to 119, on the line of numbers for the side DC.

CASE II. and III.

Two sides and an angle opposite to one of them being given, to find the other opposite angles and the third side.

The side BC 365, and the side AB 640, and angle A 26 given, to find the side AC, and angles ABC and BCA.



CONSTRUCTION.

Draw the indefinite line FE, and on any point thereon, as at A, draw the angle DAE 26°. On AD set off AB=640, then on B, with 365 in your compasses, taken from the same scale, describe an arch which will cut FE in the point C. Join BC, and it is done; AC will measure on the scale before used 809 nearly, the angle B will measure on the scale of chords 103¾, and angle C 50¼ nearly.

Proportion by Axiom II.

To find the angle C.		To find AC.	
As the side BC 365 co. ar.	7,43771	As sine ang. C 50° 14′ co. ar.	0,11427
Is to the sine of angle A 26°	9,64184	Is to AB 640	2,80618
So is the side AB 640	2,80618	So is si. ang. B, or its suppl. 76° 14′	9,98734
To sine angle C 50° 14′	9,88573	To side AC 808.7	2,90779

Angle A add	26	0
	76	14
Subtract from	180	
Angle B	103	46

It may be proper to observe, that if the given angle be obtuse, the angle sought will be acute; but when the given angle is acute, and opposite a given lesser side, then the required angle is doubtful whether acute or obtuse, it ought therefore to be determined before the operation; for it is plain the above proportion produces 50° 14′ for the required angle, but if it is obtuse, its supplement to 180° must be taken, viz. 129° 46′

By Gunter.

1st. The extent from 365 to 640, on the line of numbers, will reach from 26° to 50° 14′ on the line of sines, equal to the angle C.

2d. The extent from 50° 14′, to 76° 14′, on the line of sines, will reach from 640 to 809 on the line of numbers, equal AC.

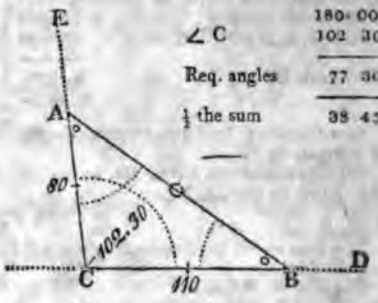
AXIOM III.

triangle it will be, as the sum of any two sides, is to their difference, so is the
e sum of the angles opposite these sides, to the tangent of half their difference,
ence being added to half the sum of the angles, gives the greater angle, but,
the remainder will be the lesser angle.

CASE IV. and V.

their contained angle
nd either of the other
ird side.
10, AC 80, and angle
find the angles BAC

C	110
C	80
des	190
f sides	30



	180 00
∠ C	102 30
Req. angles	77 30
½ the sum	38 45

CONSTRUCTION.

finite right line CD, on which set off CB=110, make the angle ACB=
n AC set off CA 80, join AB, and it is done, for AB will measure on the
, and the angles A and B will measure 45° 58′, and 31° 32′, respectively, on
s.

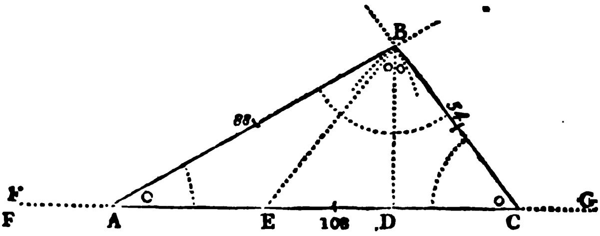
The proportion by Axiom III. will be,

the angles B and A.		To find the side AB by Axiom III.	
e sides AC and BC 190 co. ar.	7,72125	As sine ang. B 31 32 co. ar.	0,28150
		Is to AC 80	1,90309
nce 30	1,47712	So is sine ang. C 102 30	

CASE VI.

The three sides of a plane triangle given, to find the angles.

The side BA 88, BC 54, AC 108, given to find the angles ABC, BAC, BCA.



CONSTRUCTION.

Draw the indefinite right line FG, on which, from any point therein, as at A, set off AC 108, then 88 in your compasses, and one foot on the point A, sweep an arch also with the distance 54 in your compasses, and one point on C, sweep another arch intersecting the former arch in the point B, and it is done; BA, BC, AC, will measure 88, 54, 108 respectively on the same scale.

The proportion by Axiom IV.

AB	88	
BC	54	
	142	Sum of shortest sides
	34	Diff. ditto
Half base	54	
Half diff. segm.	22.35	
AD	76.35	Great segm.
DC	31.65	Least segm.

To find AE=AD—DC the diff. of segments.

As the side AC 108 co. ar.	7.96658
Is to the sum of sides AB and BC 142	2.15229
So is diff. sides AB and BC 34	1.53148
To AE the diff. of seg. of base 44,7	1.65035
Half	22.35

Having divided the triangle into two right-angled triangles, the hypotenuse and bases of which are given, to find the angles by Axiom I. as follows;

To find the angle DAB.

As the hypotenuse AB 88 co. ar.		8.05552
Is to radius	90°	1.00000
So is side AD the great seg.	76 35	1.88281
To sine ang. CBD	60° 11′	9.93833
	90	
The com. is ang. A=	29 49	

To find the angle DBC.

As hypot. BC 54 co. ar.		8.26761
Is to radius	90°	10 00000
So is DC 31.65		1.50037
To si. ang. CBD	35° 53′	9.76798
	90	

Its com. ang. C=54 07+ang. A. 29° 49′=83 56 and 180—83° 56′=ang. B. 96° 4

OBLIQUE SAILING.

WE come next to the doctrine of oblique triangles applied to problems of sailing. and though it may be applied to the measuring of inaccessible objects, yet we shall confine it to those problems which are more immediately necessary in navigation, and is chiefly used in taking the maps of harbours, sea-coasts, &c. as follows.

Oblique Sailing exemplified by proper Examples.

CASE I.

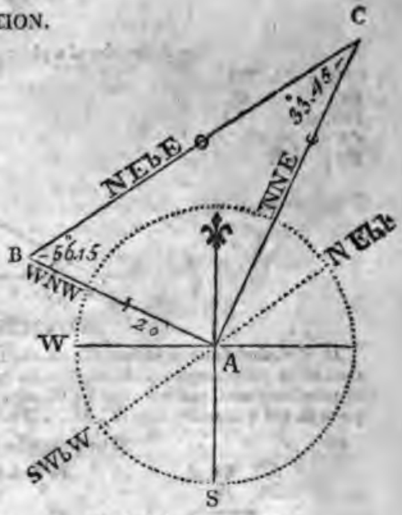
The bearing and distance of two places from each other, as also the bearing of each of them from a third place, being given, to find the distance from the said third place to each of the other two places.

EXAMPLE.

Coasting along shore, I saw a cape of land which bore from me N. N. E. I stood away W. N. W. 20 miles, and the same cape bore from me N. E. by E. I would know the distance of the ship at both stations from the cape.

CONSTRUCTION.

n the compass N. E. S. W. let
place of the ship at her first
hence, through the N. N. E.
indefinite right line CA, also
. N. W. point, draw another in-
ne, BA, and set off thereon 20
ale of equal parts from A to B;
tre of the compass also draw the
d S. W. by W. points, and pa-
om the point B, draw the line
e N. N. E. in the point C, and
from the N. eastward, 2 points
N. westward 6 points, together
for the ∠BAC, also the differ-
he N. E. by E. and N. N. E.
=33° 45′=∠BCA, and the
een W. N. W. and S. W. by W.
56° 15′=∠ABC, then the
BC=90°, therefore the other is
r 90°.



ind the distance AC.		To find the distance BC.		
CB 33° 45′ co. ar.	0.25526	As sine ang. ACB 33 15 co. ar.		0.25526
20 mi.	1.30103	: AB	20 mi.	1.30103
BC 56 15	9.91985	:: S. ang. BAC=90 0		10.00000
her 1st } miles.	1.47614	: dist. BC = 36 mi.		1.55629

EXAMPLE II.

, I saw two headlands, whose bearing from one another I found by the chart to
nd E. by S. distance 15 miles, the northernmost bore from me S. S. W. and the

This example, and the first, are used for finding the distance of a ship from any headland, &c. when the ship is about to take her departure from the land.

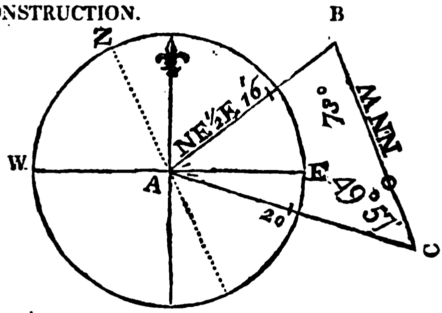
CASE II.

The bearings and distance of two places from each other, and the distance of one of those places, and the bearing of the other from a third place, being given, to find the bearing of the first, and the distance of the second from the third place.

EXAMPLE I.

Admit two ships sail from the same road, one sails N. E. ½ E. 16 miles, the other sails 20 miles, and then finds the first to bear N. N. W. I demand the distance between the two ships.

CONSTRUCTION.



1st. Having drawn the compass, let A be the place the ships departed from, and draw the N. E. ½ E. line AB equal 16 miles.

2d. From B draw the right line BC parallel to N. N. W. then with 20 miles between the compasses, setting one foot in A, with the other intersect the line BC as in C, and join AC, then is the ∠BAC the course which the second ship steered, reckoned from the N. E ½ E. southerly.

Calculation of the Angles.

The bearing from B to C is S. S. E. the opposite point to N. N. W. which is two points, also A bears from the same point B, S. W. ½ W. the opposite point to N. E. ½ E. which is 4½ points and two from the S. easterly, make 6½ points for the ∠ABC, from whence you find the ∠C thus:

As the side AC=20 miles	co. ar.	8.69897
Is to the sine of the ∠ABC 6½ points=73° 7′ 30″		9.98088
So is the side AB 16 miles		1.20412
To the sine of the ∠C 49° 57′		9.88397
To N. N. W. add 22 30		
Sum makes 72 27 from the N. westerly.		

Which being counted from the N. N. W. makes AC to bear 72° 27′ westerly, whence the ship's course was from A to C 72° 27′ easterly, or E. S. E. ½ E. nearly.

To find the Distance of the two ships from one another.

The ∠ABC=73°	7′	As sine ∠ABC 73° 7′ co. ar.		0.01912
∠C=	49 57	Is to side AC=20		1.30103
		So is sine ∠56.56		9.92326
Sum	123 4			
	180	To side BC—17.1 miles.		1.24341
∠A	56 56			

CASE III.

The bearings and distances of any two places from a third being given, to find the bearings of the said places, and their distance from each other.

EXAMPLE I.

Admit two ships set sail from the same port, one whereof sails N. W. 30 miles, the other sails N. E. by N. 40 miles. I demand their bearings and distance from each other.

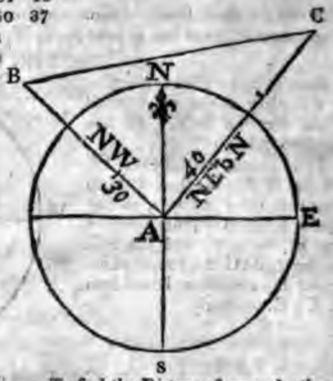
OBLIQUE SAILING.

CONSTRUCTION.

To calculate the Angles.

N. E. by N. 3 points	33° 45′	Side AB	30
N. W. 4 points	45	Side AC	40
∠BAC	78 45	Sum of sides	70
	180		
		Difference	10
Sum of unknown ∠s 2)101	15		
½ sum opp. angles	50 37		

ff the N. W. course AB, which , also draw the second ship's et off thereon 40 miles from the B BC, and it is done.



B &AC=70 co. ar.		8.15490
ence	10	1.00000
opp. ∠s 50 37		10.08570
	9 52½	9.24060
m	60 30	

To find the Distance from each other.

As the si. angle B	60° 30′ co. ar.	0.06030
Is to side AC 40′		1.60206
So is sine ang. A 78° 45′		9.99157
To their dist. BC=45.01		1.65393

By Axiom IV.

As the base B D	400 co. ar.		7.39794
Is to sum of sides BC and CD	750.7		2.87547
So is diff. of sides BC and CD	150.7		2.17811
To diff. segts. of base	262 8		2.45152
Half which	141 4		
Add to ½ base	200 0		
Sum is gr. segt. AD =	341 4		
Diff. = the less segt. AB	58 6		

To find the Course from B, *in* ∠BCA.

As hypot. BC	300	co. ar.	7.52288
Is to radius	90		10.00000
So is AB	58.6		1.76790
Co-sine ang. B	78° 44′		9.29078
Add E. by N.	11 15		

To find the Course from D, *in* △ACD.

As the hypot.	450.7	co. ar.	7.34611
Is to radius	90		10.0000
So is A D	341.4		2.53326
To co-sine ang. D	40.45		9.87937
Subtract E. by N.	11.15		

Remains W. 29 30 N. for the ship's course from D, the easternmost port.

Sum E. 89 59 N. or N. the course from B, the westernmost ship's port.

CASE V.

The bearings of two or more places from two different stations, as also the bearings and distance of the said stations from each other, being given, to find the bearings and distance of the said places from each other.

This case is a compound of the first and second Cases.

EXAMPLE I.

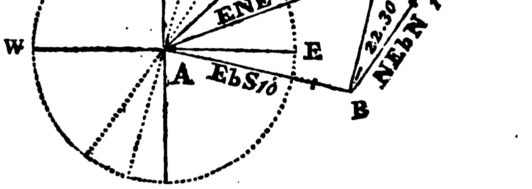
Coasting along shore, I saw two headlands, the first bore from me N. E. the second E. N. E. and after I had sailed E. by S. 10 miles, the first bore from me N. by E. and the second N. E. by N. I demand the bearings of the two headlands from each other.

CONSTRUCTION.

1st. Having drawn the compass N. E. S. W. let A represent the place of the ship, from whence draw the N. E. line A C, the E. N. E. line A D, and the E. by S. line A B = 10 miles, then will B be the ship's second station.

2d. From B draw the line B C parallel to the N. by E. Where this intersects the N. E. line, as in C, gives the first headland.

3d. Also from B draw the line B D parallel to the N. E. by N. Where this intersects the E. N. E. line, as in D, gives the second headland.



4th. Join the points C and D, then will CD be the distance of the headlands from each other and the ∠ A C D their bearing from the N. E. line, to find which by

CALCULATION,

you must find the distance of both headlands from both stations.

ABC all the ∠s are given,
10 miles.
S. and N. by E. are eight
tly the ∠ ABC is right-an-

and E. by S. is 5 points, or
5′. Its comp. ∠A C B
△ ACB,

=33° 45′ co. ar.		0.25526
= 10		1.00000
=56 15		9.91985
	14.97	1.17511

rly.

△ CBD is given the side
le BD 10 miles, and ∠CBD.
e N. by E. and N. E. by N.
∠CBD=22° 30′.

C & BD=24.97		8.60258
& BD	4.97	0.69636
p. ∠s=78° 45′		10.70184
ce	45 2	10.00028
B	123 47	
D	33 43	

2. In the △ A D B.

Betwixt E. N. E. and E. by S. are 3 points $=\angle DAB\ 33^\circ 45'$.

Betwixt E.N.E. and N. E. by N. is 3 points, so that the ∠ ADB is $=33^\circ 45'$; now there are 2∠s equal, consequently there must be two sides equal, viz. the sides opposite those angles, that is, the side AB = the side BD = 10 miles; and the △ ABD is an isosceles△.

180	
22	30
2)157	30
78	45

As sine ∠BCD	33 43 co. ar.	0.25564
: to BD	10 0	1.00000
: : sine ∠CBD	22 30	9.58284
: C D the distance of both	68.9	1.83880

Again,

From ∠ B C D = 33 43
Subtract N. by E. 11 15

22 28 that is, D bears from C, S. 22 28 E. or S. S. E. and C the contrary from D.

MANNER OF SURVEYING COASTS AND

from this station, for which purpose prepare an observation-table, in which write distinctly and regularly the several celestial observations, bearings, distances measured by the log-line, the rocks, shoals, soundings, overfalls, races of tides, and other remarks that may be made along the coast; the table may consist of 7 or 8 columns disposed in the following order:

NOTE.—The sextant will be found the readiest and most correct instrument to take the angles, by being held in a horizontal position, by which means any two objects, not exceeding 120°, may be brought into contact; it will not be amiss to take material points by the compass, and intermediate ones by the sexant or quadrant.

Observations in navigating the Coast —— from Cape —— to Point ——, being —— Miles, measured by the Log, the Cou. from Station 1 to 2, being S. ¼ W.

Year, Month and Day.	Sun's Mer. Alt.	Bearings at station. 1	Time and distance sailed from station. 1		Bearings and distances taken at these distances.		Bearings of rocks, shoals, and their estimated distance when on a line with a point or heads of the coast.	Remarks on the tides, nature and dimensions of rocks, shoals, and anchorage.
	D. M.		H.M.	Miles		Fath.	Points and heads. M.	
			1.27 11.45	¾ 5	A. N. 5° W. B. W. 20° S.	22		This rock dries and seemed 100 yds. N. & S. a leading mark to it is

While the vessel is running the base line from station to station, an accurate appearance of the coast should be made, to do which, let four expert persons be appointed, one to take the bearing exactly with an azimuth compass; one to oversee the running out of the log-line, and to keep an account of the ship's way, so as to be readily able to tell the distance run when required; the third to attend the heaving of the lead, to write down the soundings and bearings of one or two head points, or remarkable points of the coast, taken at each depth; the fourth a draftsman, to draw out the necessary bearings and distances, and delineate the figures and windings of the coast at each station, and to correct their forms and dimensions when the ship is sailing along the land. Then let the several bearings be corrected by the variation to reduce them to their true positions; then, in some convenient part of a sheet of paper, describe a circle, the larger the better, on which lay off the several bearings taken from the first station, and let them be numbered 1, 2, 3, &c. on the outside of the circle; also lay down the several bearings taken at the 2d station, let these be numbered with the same figures on the inside of the circle.

Draw a line to express the ship's run, both in length and course, and from the end of the line, expressing the first station, draw lines parallel to the respective bearings taken at that end, and note it in the circle; mark the intersections of each pair of lines, directed to the same point, with the numbers annexed to their bearings; and, through the intersections so marked, draw by hand a curved line; observe to wave the line in and out, as near as can be, like the bending of the coast itself.

Against each part draw the appearance of the elevated or low ground, in the sketches, distinguishing rocks, cliffs, or high lands, low lands, sand hills, &c. If there are any currents or eddies, express them in their proper places, by darts or arrows, the points being turned that way the currents set; put in the several soundings at low water, in small figures, distinguishing whether fathoms or feet; show the time of high water on the full and change days by Roman figures, and tell the rise in feet: put in a compass with a scale of miles or leagues, such as the vessel's run was laid down by; add the name of the place, the coast, and the latitude and longitude, as true as can be obtained.

If there is a shoal or sand on the coast, let it be taken by a boat sailing round it, and keeping an account of the courses, distances, and soundings, to be put in the draft; the boat must, from some part of the said sand or shoal, take the bearings of two points of the coast, where bearings have been taken from the ship; or the bearing of the boat, or some part of the shoal, or some beacon in that place, must be taken by the ship, at the stations where she takes the bearings of the shore; for, by either of these means, one point of the sand being obtained, the rest of it can be laid down from the boat's account.

If the coast to be drawn is a bay or harbour, winding in such a manner that all its parts cannot be seen at two stations; let as many bases or lines be drawn, and exactly measured, as may be found necessary, observing that the several distances run should join to one another, in the nature of a traverse; that each new set of objects or points observed should be taken from two stations at the end of a known distance, and that the objects whose bearings are taken do not so much extend beyond the limits of the base, as to make angles with it less than about ½ or ¾ of a point, but rather reserve such objects for the next measured base line; for when lines lie very obliquely to one another, their intersections are not easily ascertained.

Thus may a coast of any extent be surveyed, by carefully measuring of stationary base lines, and from their ends drawing angles to each other.

If any particular parts of the harbour cannot be conveniently seen from either station, take the boat into those places, and, having well examined them, make sketches thereof, estimating the length and breadth of the several inlets, either by the rowing or sailing of *the boat;* take as many bearings, soundings, and other notes, as

may be thought necessary; then annex these particular views in their proper places in the general draft.

If there are any dangerous sands or rocks, besides inserting them in their proper places, there should be a double line drawn through that point, on one or more objects ashore: and for this purpose choose a church, mill, house, noted tree, a cliff, or any remarkable thing that can be distinctly seen at sea, and which can be brought to bear in the same right line with the point to be avoided; but if that point is under water, there must be two land-marks brought to bear with the danger, either in a right line, when it can be, or in two lines, and those two lines, and those land-marks, may be put down in their proper places, by their intersection of two objects in one bearing, and two objects in another bearing; which will give the station of the ship, and the distance and the bearing of the danger from that station, noted when near or on it; but if two such intersections cannot be obtained, it must be put down from the two points on shore, in one with the computed distance therefrom, or from the intersecting bearings of two single points on shore.

It should be remarked in the draft, what places, if any, are unfit for anchorage, and what are fit, by writing Rocky ground, Foul anchorage, Good anchorage; and in the latter, to draw the figure of an anchor. Also, if there is any particular channel more convenient to sail through than another, it is to be pointed out by lines drawn to its entrance, from two or more noted marks on shore.

The foregoing method of surveying a coast, supposes in general that it is taken by a ship in her passage along, not having an opportunity of going ashore. But when circumstances will permit the measures and observations to be made on land, the survey can be more accurately taken than on the water.

To survey a Harbour by Observation ashore.

MAKE an eye-draft of the place to be surveyed: and, in going round its coast, fix, in the most remarkable points and bends of the shore-station, staves or straight poles, tall enough to be seen at a considerable distance; but if at any of those places there is a noted tree, house, or any other remarkable thing, that object may serve instead of a station-staff; and it will be convenient to black the staves, and tie a piece of white bunting to the top of each, then, in the eye-draft, put letters at the noted points, or marks, for distinction-sake.

Choose the most level spot of ground, wherein a base line may be measured, of one or more half miles in length, or a length of not less than a tenth part of the distance of the two extreme objects marked for observing, and let the direction of the measured base line be so laid out, that from both ends of it as many of the station staves before planted, or the objects before remarked, may be seen; the bearing or position of this base must be determined by degrees

and minutes, and also its length must be accurately measured to feet and parts, either by a measuring chain, or by a piece of log-line of 100 feet long, properly marked at the end of every 10 feet.

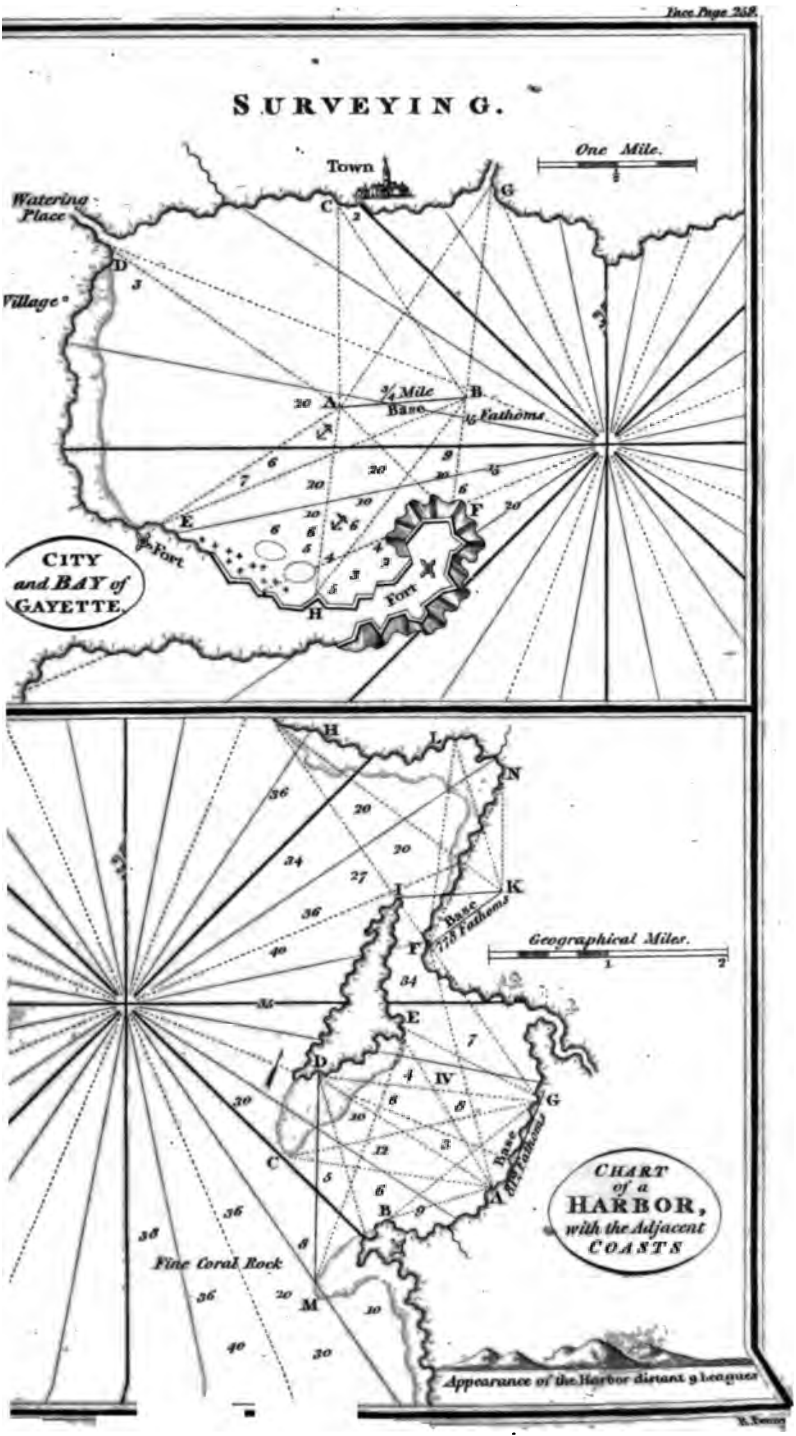
From one end of the base observe, with any instrument proper to take bearings, the position or bearing in degrees and minutes of all the staves or objects within view, and write them down orderly: do the same from the other end of the base, and let all the bearings be corrected by the variation of the compass.

Then these measures and corrected bearings being plotted or laid down, will give the most conspicuous points on shore, the intermediate spaces are to be filled up from the sketches of them made on the spot.

But if any such objects should spread on either hand, so far from beyond the limits of the base, that at either end thereof, the other end and those objects or staves should appear nearly in the same direction, or to make $\angle$s of not exceeding 10°: or, if some of the remarked objects can be seen only from one end of the base, then let the bearings of such objects be taken from a place whose position has been determined from both ends of the measured base; or if there are several remarked objects which cannot be seen from either end of the base lines, let the bearings of such objects be taken from each of the two points whose position has been taken from both ends of the base; or, it may on some occasions be proper to choose another place on which another base of a convenient length may be measured, and from the extremities of which the ends of the first base may be seen, and also as many as can be of the remaining objects which lay too obliquely for the first base, or which could not be seen from it; in such manner proceed until the bearings are taken of all the points judged necessary for completing the survey of the limits of the harbour.

If a base line of a sufficient length cannot be measured in one right line, it may be taken in two adjoining lines, as the two sides of a triangle, the included angle being accurately taken, and the bearing of either line.

When the outlines or limits of an harbour, bay, road, &c. are delineated by the preceding precepts, let a small vessel go out to sea to take drawings of the appearance of the land, and its bearings. Sail likewise into the harbour, and draw the appearance of its entrance; take particular notice if there are any false resemblances of the entrance by which ships may be deceived and run into danger; or when any two objects being brought in a line, or in one, will lead into the harbour without danger; when it can be done, search for the best anchoring places, and if possible denote those places, by bringing two objects in one, if not the exact bearings of two or three other objects, so that the places may be easily determined, the chart being correctly drawn, a compass with the variation and scale properly fitted to the plan, the isles, rocks, sands, &c. marked in their proper places, with their soundings at low water, and the winds open to them, the best track with the sound-


SURVEYING.
Town
One Mile.
Watering Place
Village
¾ Mile Base
15 Fathoms
Fort
Fort
CITY and BAY of GAYETTE.
Geographical Miles.
Base 778 Fathoms
Base 675 Fathoms
CHART of a HARBOR, with the Adjacent COASTS
Fine Coral Rock
Appearance of the Harbor distant 9 Leagues

ings all the way to those anchoring places, the proper sailing marks to avoid dangers; the winds, if any troublesome ones, which prevail, and at what seasons; the places where fresh water can be got, the name of the place, the country in, on what sea, the latitude and longitude, a sketch of the appearance the place makes at sea upon a known rhumb, and at an estimated distance. Add whatever else a judicious seaman shall think proper to insert; then is the plan fit for all nautical purposes, and may be embellished with proper colours, if necessary.

Sea-drawings, taken according to the foregoing precepts, besides the real use they are of, cannot fail to recommend the young mariner who surveys and constructs them, to the notice of his superiors.

To reduce a Draft to a smaller Scale.

WITH a black lead pencil draw the draft to be reduced all over with cross-lines, forming exact squares, draw the clean paper for the copy all over with the same number of squares, but their sides larger or smaller in proportion to the intended size of the scale, such as $\frac{1}{2}$, $\frac{1}{3}$, &c. length of the other, distinguish by a stronger mark, with a figure every fifth or sixth row of squares in both, so that the several corresponding squares may be readily perceived; then, in each of the squares of the draft, draw, by the eye, a curve on the paper, similar to that in the square of your copying draft, till the whole is copied; make the black lines with India or other ink, and when drawn, the black-lead lines may be rubbed out with bread or India rubber.

I here give two Examples, as an elucidation of what has last been said.

EXAMPLE I.

AB is the base line, equal to $\frac{3}{4}$ Mile.

BG=N. 5° E.	1	Station at B, with Bearings.	AG=N. E. by N.	1	Station at A with Bearings.
BC=N. 25 W.	2		AC=N.	2	
BD=N. 53 W.	3		AD=N. 53° 25′W	3	
BE=W. S. W.	4		AE=S. W. by W.	4	
BH=S.W. by S. $\frac{1}{2}$W.	5		AH=S. $\frac{1}{2}$ W.	5	
BF=S.	6		AF=S. E.	6	

These instruments give the points G, C, D, E, H, F, in order from each station; that is, BG and AG intersect, as also BC and AC, &c.

Observe, the last letter must be the same in both bearings, and it will be the best to follow the bearings one way all round the compass from the first station; as also when arrived at the second station, begin with your first object seen at first station, and follow the letters round belonging to each object, by which the last letter in each bearing will successively follow in order.

This is an example when on board ship.

EXAMPLE II.

This harbour was surveyed by base lines taken on shore, which, when it can be done, is far preferable.

The base line AG 812 fathoms, was taken, as by directions, on the most even spot on shore; now, beginning from point A,

AB=W. by S. $\frac{1}{2}$ S.	Bearings from Station A.	GB=S.S. W.	Bearings from Station G.
AC=W. by N.		GC=W. by S. $\frac{3}{4}$ S.	
AD=W.N.W.$\frac{3}{4}$N.		GD=W. $\frac{3}{4}$ N.	
AE=N.N.W. $\frac{3}{4}$W.		GE=W.N.W. $\frac{1}{2}$ N.	
AF=N. by W. $\frac{1}{2}$W.		GF=N.W. by N.$\frac{3}{4}$N.	
AG=N. N. E.	812 fath.		

After having made these observations, it will be necessary to proceed to the northern part of the coast. In all cases where a coast is surveyed in several parts, it is most advisable to measure a new fundamental base for each part, when it can be conveniently done. A line measured from the station F, towards K, is well adapted to our purpose. Let FK, therefore, be the second base line; its length, by admeasurement, is found to be 778 fathoms; and its bearing, by compass, N. E. $\frac{1}{4}$ E. Take bearings from each end of this base as before.

FIandFH=N.W.byN.$\frac{3}{4}$N.	Bearings from StationF.	KF=S.W.$\frac{3}{4}$W.	Bearings from Station K.
FL=N. $\frac{1}{4}$ E.		KH=N. W.$\frac{1}{4}$ N	
FK=N.E.$\frac{1}{4}$E 778 fath.		KI=W.$\frac{1}{2}$ S.	
		KL=N.byW.$\frac{1}{2}$W	
		KN=N.$\frac{3}{4}$E.	

It is plain, that the connexion between the two parts of this survey is preserved by the second fundamental base being drawn from the point F, whose situation was before determined by observations from the first base line. If this particular position of the first base line had not been convenient, and it had been taken at a distance from every point determined in situation from the first base line, the connection would have required an observation of the bearing of one of the said points from each end of the second base. Thus, suppose the line IK to be the second base line, instead of FK, the position of IK, with respect to the given point F, may be known by taking the bearing of F from I and K.

The end of the shoal, marked M, lies with D, bearing N. and E. N. by E. $\frac{1}{4}$ E.

All the observations which are required to be made on shore being completed, through the intersections of the bearings draw the configuration of the coast, as before directed, and finish the drawing by the instructions there given; which if well attended to, no difficulty can well occur.

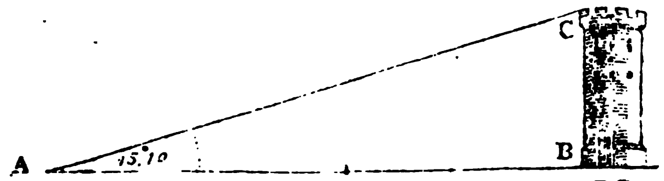
To find the Height and Distances of Objects at Sea.

WHEN the object is perpendicular, and the distance to it can be measured, find the angle of altitude with a quadrant, and measure the distance to it as exact as possible, and then you have

the angles and base, to find the perpendicular; or, if you go backward or forward until the angle of altitude be 45°, the distance between you and the object will be the perpendicular height.

EXAMPLE I.

Being 69 fathoms from the bottom of a tower, I find its altitude, after allowing for the height of my eye, above the water 15° 10′. Required the height?

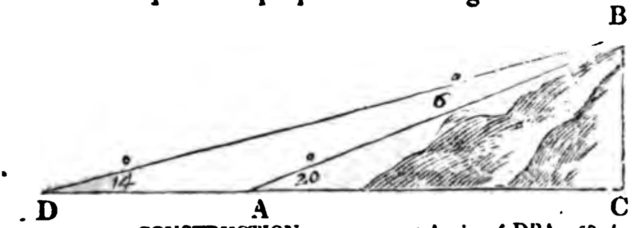


Draw AB=96, upon B erect the perpendicular BC, and draw AC, making an angle with AB=15° 10′ till it cuts BC in C, then will BC be the height of the tower. Or,

As radius	10.00000	As co-si. ang. A co. ar.
Is to the base 96	1.98227	: Base 96
So is tang. ang. A, 15° 10′	9.43308	: : S. ang. A
To the height BC 26.2	1.41535	: the perpen.

EXAMPLE II.

Being at sea, I observed the altitude of a mountain, and found it 20°, and then sailing from it in a direct line four miles, I found the altitude of the mountain to be 14°, dip and refraction allowed for. I require the perpendicular height.



CONSTRUCTION.

Draw the horizontal line DC.

On any point A make the ∠BAC=20°, from A set off four miles to D, on D make the ∠BDC=14°, and from where the line DB cuts the line AB as at B, let fall the perpendicular BC on the base DC, and BC measured will be the perpendicular height required.

	180 0
The angle BAC	20 0
The ang. BAD=	160 0
The ang. ADB=	14 0
	174 0
	180 0
The angle ADB=	6 0

As sine ∠DBA=6° 0′	co. ar.	0.98077
: AD=4 miles		0.60206
: Sine ∠BDA 14°		9.38638
: AB=9.258	=	0.96651

Then △ ABC given AB=9.258 and ∠A find BC.

Radius		10.00000
: A	9.258	0.96651
:: Sine ∠	20	9.53405
: BC=3.166		0.50056

So that the height of the mountain is 3 miles $\frac{165}{1000}$ = 1 furlong, 13 poles, &c.

NOTE. In finding the ∠ DAB see Prob. 5th in Geometry.

Of the Curvature of the Earth.

MOST persons know that if they are raised above the surface of the adjacent land or water, they can not only see different objects that lie on that surface better, but also see those more and more remote as they advance higher. The irregularity of the surface of the land will not be subjected to any one rule that will give the distance to which objects may be seen at different elevations; but at sea, where there is generally an uniform curvature of the water, upon the supposition of the spherical form of the earth, those distances may be easily computed.

RULE.

To the earth's semi-diameter add the height of the eye, multiply the sum by the height, then the square root of the product is the distance at which an object on the surface of the water can be seen by an eye so elevated; and by this rule was Table XXI. computed, the diameter of the earth being taken at 41798117 feet, according to Sir Isaac Newton's measures. This Table may be usefully applied to estimate the distance of an object at sea, the elevation of that object above its horizon being known.

EXAMPLE I.

Sailing towards a headland, on which is a light-house elevated 600 feet above the surface of the water, we saw the lights at night just appear in the horizon; how far were we at that time distant from that light-house?

Look in Table XXI. for 600 feet in the column marked Height in Feet, and right against it, in the column marked Distance in Miles, is 29.994. So that the distance may be reckoned about 30 miles.

EXAMPLE II.

Being in company with some merchants walking on a sandy shore, on the look-out for a vessel which was expected, whose top-gallant mast was 140 feet above the surface, allowance being made for her immersion in the water, we observed through the telescope a ship's vane just appearing in the horizon. How far off is that ship, supposing it the vessel expected? Answer, against 140 feet, the height, stands 14.488. that is her distance; here is no allowance made for the height of the eye above the horizon; but it is obvious that the higher the eye, the farther it can see: now as objects are seen in a straight line, and that line is a tangent to the earth's surface, therefore it follows, that to find the distance of two elevated

objects, when the right line joining them touches the surface of the earth between those objects, look for the distance answering each height, and their sum is the distance required.

Thus, in the second example, suppose the eye raised six feet above the water's edge, it can see an object on the surface 2.999, or three miles off. This distance added to 14¼ miles, make the distance of the ship to be 17¼ miles.

EXAMPLE III.

A man being on the main-top-gallant mast of a man of war, 200 feet above the water, sees a 100 gun ship she had engaged the day before hull-to; how far were those ships distant from one another?

A ship of 100 guns, or a first-rate man of war, is above 60 feet from the keel to the rails, from which deduct about 20, leaves 40 for the height of her quarter above water. Now a ship is seen hull-to when her upper works just appear.

Then 200 feet high gives	17.316 miles.
And against 40 stands	7.744
	25.060 miles is her distance

CURRENT SAILING.

CURRENTS are certain settings of the streams, by means of which all bodies moving therein are compelled to alter their course and submit to the motion impressed upon them by it: whence, if a current sets with the course of a ship, it augments her motion by as much as the drift or rate of driving it.

Thus, if a ship sails N. N. E. 20 miles, in a current that sets N. N. E. 8 miles in the same time, her true course will be N. N. E. 28 miles in that time; but if a current sets against a ship, it lessens her velocity by just as much as the current's drift is.

So that if the ship sails N. E. 49 miles, in a current that sets S. W. 10 miles in that time, then her true course will be N. E. 39 miles; and if in the same time that the ship sails N. E. 49 miles in a current that sets S. W. 59 miles, then the ship will fall astern, and her true course with be S. W. 10 miles; but if the ship thwarts the current, it not only lessens or augments her velocity, but gives her a new motion, compounded of that of the ship and current.

If a body be agitated by two motions at the same time, the one with a certain velocity that will carry it according to the direction of the line AB, the length AB in a certain *space of time*, the

other according to the direction of the line AD, with a velocity that will carry it to the distance AD in the same time, then the body will describe the diagonal AC, and at the end of that time will be found in the point C.

The setting and drifts of the most remarkable tides and currents are pretty well known, but if in unknown currents, the usual way to find the setting and drift is thus :

Let three or four men take a boat a little way from the ship, and, by a rope fastened to the boat's stem, let down a heavy iron pot, or loaded kettle, into the sea, to the depth of 80 or 100 fathoms when it can be, whereby the boat will ride almost as steady as at anchor, then heave the log, and the number of knots run out in half a minute will give the miles which the current runs per hour, and the bearing of the log shows the setting of the current.

EXAMPLE I.

If a ship sails E. N. E. 98 miles in a current that sets S. W. 27 miles in the same time, what is her true course and distance?

	180°	0′
	22	30
	2)157	30
½ Sum of req. <s	78	45

CALCULATION.

The opposite point to S. W. is N. E. which taken from E. N. E. leaves 2 points=22° 30′, between them for the ∠ C.

Now we have in the △ ACB the side AC, side CB, and the ∠C given, to find the ∠ A, ∠ B, and side AB=distance by Axiom III.

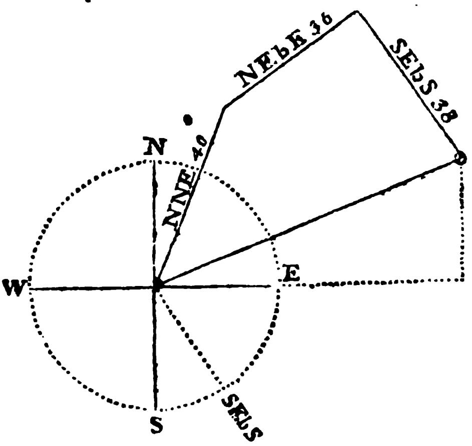
Side	AC	98	As sum of the sides	125 co. ar.	7.90309
Side	BC	27	: their diff.	71	1.85126
Sum of sides		125	: : tan. ½ sum of opp. ∠	78 45	10.70134
Diff.		71	: tan. of ½ their diff.	70 42	10.45569

To ½ sum of the ∠s	78° 45′	To find the dist. AB by Axiom II.			
Apply the ½ diff.	70 42	As sine ∠ A	8° 3′	co. ar.	0.85376
+ gives ∠ B =	149 27	: : side BC	27		1.43136
− gives ∠ A =	8 3	: : sine C	22 30		9.58284
		: side AB	73,78		1.86796

The ∠ B 8° 3′ + E. N. E. = 67° 30′ = N. 75° 33′ E. the cou. and dist. 73,78 miles for the answer.

EXAMPLE.

If a ship from the lat. 38° 40′ S. sails N. N. E. 40 miles, then N. E. by E. 36 miles, in a current that sets S. E. by S. 20 miles, in the same time that the ship sails 40 miles; I demand the distance from the first place, and also the latitude the ship is in?



CONSTRUCTION.

Having drawn the compass, draw the N. N. E. course equal to 40 miles, to the end of which join the N. E. by E. line, and set off thereon 36 from the same scale. From the end of the last N. E. by E. line set off the dist. of the current's drift, viz. S. E. by S. 38 miles: that is, as 40 the run of the ship is to 20 the run of the current, so is 76 the whole run of the ship to 38 the drift of the current, then to the end of that line to the ship's first place, will be the distance, and the angle being measured will be the ship's course, and a line let fall from this last point on the parallel of the ship's first place, will give on that parallel the departure from her first meridian.

This may be done by calculation; but that being tedious, we shall omit it, and show how it may be done by a traverse, in which we shall consider the current as a single course.

urses Miles.	Northing.	Southing.	Easting.	Westing.
N. E. 40	37.0		15.3	
E. by E. 36	20.0		29.9	
E. by S. 38		31.6	21.1	
	57.0	31.6	66.3	
	31.6			
	25.4			

at. sailed from 38° 40′ S. sub. the diff. of lat. 25 miles N.
lat. 38° 15′ S. where the ship is arrived at.

find the course.		To find the distance.		
25. 4 co. ar.	8.59517	As sine cou.	60° 3′ co. ar.	0.02970
	0.00000	. dep.	66 3	1.82151
6 3	1.82151	: : rad.		
u. 69° 3′	10.41668	: dist,	71	1.85121

ance from her first place is 71 miles

Adrift. The state of a ship broken from her moorings, and driving about without control.

Afloat. Buoyed up by the water from the ground.

Afore. All that part of a ship which lies forward, or near the stem. It also signifies *farther forward;* as, the manger stands AFORE the fore-mast; that is, nearer to the stem.

Aft. Behind, or near the stern of the ship.

After. A phrase applied to any object in the hinder part of the ship, as the after hatchway, the after-sails, &c.

A-ground. The situation of a ship when her bottom, or any part of it, rests on the ground.

A-head. Any thing which is situated on that point of the compass to which a ship's stem is directed is said to be a-head of her.

A-hull. The situation of a ship when all her sails are furled, and her helm to the lee-side; by which she lies with her head being somewhat inclined to the direction of the wind.

A-lee. The position of the helm when it is pushed down to the lee-side.

All in the wind. The state of a ship's sails when they are parallel to the direction of the wind, so as to shake, or quiver.

All hands hoay! The call by which all the ship's company are summoned upon deck.

Aloft. At the mast-heads, or any where about the higher rigging.

Along-side. Side-by-side, or joined to a ship, wharf, &c.

Along-shore. Along the coast; a coast which is in the sight of the shore, and nearly parallel to it.

Aloof. Is distance. Keep aloof, that is, keep at a distance.

Amain. At once, suddenly; as, LET GO AMAIN!

Amidships. The middle of a ship, either with regard to her length or breadth.

To anchor. To let the anchor fall into the ground, for the ship to ride thereby.

Anchorage. Ground fit to hold a ship by her anchor.

The anchor is a cock-bill. The situation of the anchor when it hangs by the stopper at the cathead.

At anchor. The situation of a ship riding at her anchor.

An-end. The position of any mast, &c. when erected perpendicularly. The top-masts are said to be AN-END when they are hoisted up to their usual stations.

Apeek. Perpendicular to the anchor, the cable having been drawn so tight as to bring the ship directly over it. The anchor is then said to be APEEK.

Arm the lead. Apply putty to the lower end.

Ashore. On the shore. It also means A-GROUND.

Astern. Any distance behind a ship, as opposed to A-HEAD.

Athwart. Across the line of a ship's course or keel.

Athwart hawse. The situation of a ship when driven by accident across the fore-part of another, whether they touch or are at a small distance from each other, the transverse position of the former are principally understood.

Athwart the fore foot. When any object crosses the line of a ship's course, but a-head of her, it is said to be ATHWART HER FORE FOOT.

ips. A direction across the ship from one side to the

hen applied to the anchor, it means that the anchor is drawn
round, in a perpendicular direction, by the cable or buoy-
opsails are said to be ATRIP when they are hoisted up to the
their utmost extent.
he command to stop, or cease, in any operation.
A shelter or screen of canvass, spread over the decks of a
off the heat of the sun. Spread the AWNING, extend it so
e deck. Furl the AWNING, that is, roll it up.
The same as ATRIP.
e anchor. To carry out a small anchor a-head of the large
to prevent it from coming home.
tern, in rowing, is to impel the boat with her stern foremost,
the oars.
e sails. To arrange them in a situation that will occasion
ove a-stern.
d fill. Is to receive the wind sometimes on the foreside of
sometimes on the other, and is used when dropping a vessel
river.
lace for ships to anchor.
the mizen. To bring the sheet to the mizen-shrouds.
To contract a sail into a narrower compass, by tying up a
ne corner.
s either pigs of iron, stones, or gravel, which last is called
ST; and their use is to bring the ship down to her bearings
which her provisions and stores will not do. Trim the BAL-
, spread it about, and lay it even. The BALLAST shoots,

ship, by any contiguous object, as a shore above her sails, as a high sea behind, &c. and thus one sail is said to becalm another.

Before the beam denotes an arch of the horizon comprehended between the line of the beam and line of the keel forward.

To belay. To fasten a rope, by winding it several times backwards and forwards on a cleat or pin.

To bend a sail. Is to affix it to its proper yard, mast, or stay.

Between-decks. The space contained between any two decks of a ship.

Bight of a rope. Any part between the two ends. BIGHT, a narrow inlet of the sea.

Bilge. To break. The ship is BILGED, that is, her planks are broken in with violence.

Bilge-water. Is that which, by reason of the flatness of a ship's bottom, lies on her floor, and cannot go to the pump.

Binnacle. A kind of box to contain the compasses in upon deck.

Birth. The station in which a ship rides at anchor, either alone or in a fleet; the due distance between two ships; and also a room or apartment for the officers of a mess.

Bitts. Very large pieces of timber in the fore part of a ship, round which the cables are fastened when the ship is at anchor. After BITTS, a smaller kind of BITTS, upon the quarter-deck, for belaying the running rigging to.

To bitt the cable. Is to bring the cable under the cross-piece, and a turn round the bitt-head. In this position it may be either kept fixed or veered away.

Bitter. The turn of the cable round the bitts.

Bitter-end. That part of the cable which stays within-board round about the bitts when the ship is at anchor.

Block. A piece of wood with running sheaves or wheels in it, through which the running rigging is passed, to add to the purchase.

Block and block. When they cannot approach any nigher.

Board-and-board. When two ships come so near as to touch each other, or when they lie side-by-side.

To board a ship. To enter an enemy's ship in an engagement.

Bold shore. A steep coast, permitting the close approach of shipping.

Bolt-rope. The rope which goes round a sail, and to which the canvass is sewed.

Bonnet of a sail. Is an additional piece of canvas put to the sail in moderate weather to hold more wind. Lace on the BONNET, that is, fasten it to the sail. Shake off the BONNET, take it off.

Boot-topping. Cleaning the upper part of a ship's bottom, or that part which lies immediately under the surface of the water; and paying it over with tallow, or with a mixture of tallow, sulphur, resin, &c.

Both sheets aft. The situation of a ship sailing right before the wind.

Bow-grace. A frame of old rope or junk, laid out at the bows, stems, and sides of ships, to prevent them from being injured by flakes of ice.

Bow-line bridles. Lines made fast to the cringles in the sides of the sails, and to which the bow-line is fastened.

Bow-lines. Lines made fast to the bridles, to haul them forward

wind, which being hauled tort, enables the ship to sail wind.

To pull upon any body with a tackle, in order to remove it.

A large piece of timber which stands out from the bows of

A particular method of veering a ship, when the swell of s tacking impracticable.

is performed by laying the head-sails aback, to pay off the hen got in the wind, in order to return the ship's head into course.

e yards. To move the yards, by means of the braces.

out. To brace the yards round for the contrary tack.

arp. To brace the yards to a position, in which they will llest possible angle with the keel, for the ship to have head-

. To ease off the lee-braces, and round in the weather-st the motion of the ship's head in tacking.

To haul up a sail by means of the brails.

name to certain ropes belonging to the mizen, used to truss gaff and mast. But it is likewise applied to all the ropes loyed in hauling up the after corners of the stay-sails.

lk. The act of beginning to unload a ship.

eer. When a ship at anchor is forced, by the wind or cur-t position in which she keeps her anchor most free of her-firm in the ground, so as to endanger the tripping or foul-r.

Burning off the filth from a ship's bottom.

A rope employed to confine a ship sideways to a wharf,

foot rope before the sail, and by which the bunt or belly of the sail is hauled up outwards.

By the board. Over the ship's side.

By the head. The state of a ship when she is so unequally loaded as to draw more water forward than she ought.

By the wind. The course of a ship as nearly as possible to the direction of the wind, which is generally within six points of it.

Cap. A piece of wood fixed on the head of the mast, through which the next mast goes.

Capstan. An instrument by which the anchor is weighed out of the ground, it being a great mechanical power, and is used for setting up the shrouds, and other work where great purchases are required.

To careen. To incline a ship on one side so low down, by the application of a strong purchase to her masts, as that her bottom on the other side may be cleansed by breaming, and examined.

Casting. The motion of falling off, so as to bring the direction of the wind on either side of the ship, after it has blown some time right a-head. It is particularly applied to a ship about to weigh anchor.

To cat the anchor. Is to hook the cat-block to the ring of the anchor, and haul it up close to the cat-head.

Cat's Paw. A light air of wind perceived in a calm, sweeping the surface of the sea very lightly. A hitch taken on the lanyard of a shroud, in which the tackle is hooked in setting up the rigging, and for other purposes.

Cat-harping. Short pieces of rope which connect the lower shrouds together where the futtock shrouds are fastened.

Caulking. Filling the seams of a ship with oakum.

Centre. This word is applied to that squadron of a fleet, in line of battle, which occupies the middle of the line; and to that column (in the order of sailing) which is between the weather and lee columns.

Chains, or Channels. A place built on the sides of the ship, projecting out, notched to receive the chain-plates, for the purpose of giving them a greater angle.

Chain-plates. Are plates of iron fastened to the ship's sides under the chains, and to these plates the dead eyes are fastened by iron strops.

Chapelling, or building a Chapel, is when a vessel on a wind, in little wind, is caught a-back, and turns round on her keel to the same tack without starting either tack or sheet.

Chafing. When two things rub and injure each other.

Chase. A vessel pursued by some other.

Chaser. The vessel pursuing.

Cheerly. A phrase implying heartily, quickly, cheerly.

To claw off. The act of turning to windward from a lee-shore.

Clear is variously applied. The weather is said to be CLEAR, when it is fair and open; the sea-coast is CLEAR, when the navigation is not interrupted by rocks, &c. It is applied to cordage, cables, &c. when they are disentangled, so as to be ready for immediate service. In all these senses it is opposed to FOUL.

To clear the anchor. Is to get the cables off the flukes, or stock, and to disencumber it of ropes ready for dropping.

Clear hawse. When the cables are directed to their anchors without lying athwart each other.

To clear the hawse. Is to take out either a cross, an elbow, or a round turn.

Clenched. Made fast, as the cable is to the ring of the anchor.

Clew down. To haul the yards down by the clew-lines.

Clew-lines. Are ropes which come down from the yards to the lower corners of the sails, and by which the corners or clews of the sails are hauled up.

To clew up. To haul up the clews of a sail to its yard by means of the clew-lines.

Close hauled. That trim of the ship's sails, when she endeavours to make a progress in the nearest direction possible towards that point of the compass from which the wind blows.

To club haul. A method of tacking a ship when it is expected she will miss stays on a lee shore.

Coasting. The act of making a progress along the sea-coast of any country.

Cockbill. See *the Anchor is.*

To coil the cable. To lay it round in a ring, one turn inside another.

Commander. A large wooden mallet to drive the fid into the cable when in the act of splicing.

To come home. The anchor is said to come home when it loosens from the ground by the effort of the cable, and approaches the place where the ship floated at the length of her moorings.

Coming to. Denotes the approach of a ship's head to the direction of the wind.

Course. The point of a compass to which the ship steers.

Crank. The quality of a ship, which, for want of a sufficient ballast, is rendered incapable of carrying sail without being exposed to danger.

Creeper. A small iron grapnel used to drag in the bottom of rivers, &c. for any thing lost.

Cringle. A strand of small rope introduced several times through the bolt rope of a sail, and twisted, to which ropes are fastened.

To crowd sail. To carry more sail than ordinary.

Crow-foot. Is a number of small lines spread from the fore parts of the tops, by means of the piece of wood through which they pass, and being hauled taut upon the stays, they prevent the foot of the topsails catching under the top rim; they are also used to suspend the awnings.

Cunning. The art of directing the helmsman to guide the ship in her proper course.

To cut and run. To cut the cable and make sail instantly, without waiting to weigh anchor.

Davit. A long beam of timber used to fish the anchor. See FISH THE ANCHOR.

Dead water. The eddy water, which appears like whirlpools, closing in with the ship's stern, as she sails on.

Dead lights. A kind of window-shutter for the windows in the stern of a ship, used in very bad weather.

Dead wind. The wind right against the ship, or blowing from the very point to which she wants to go.

Dead eyes. Blocks of wood through which the lanyards of the shrouds are reeved.

To deaden a ship's way. To impede her progress through the water.

Dismasted. The state of a ship that has lost her masts.

Dog-vane. A small vane with feathers and cork, placed on the ship's quarter for the men at the cun and helm, to direct them when the vessel is nigh the wind.

Dog-watch. The watches from four to six, and from six to eight, in the evening.

Doubling. Board, thicker than sheathing, which being nailed to the bottom will stand caulking.

Doubling. The act of sailing round or passing beyond a cape or point of land.

Doubling upon. The act of enclosing any part of a hostile fleet between two fires, or of cannonading it on both sides.

Downhaul. The rope by which any sail is hauled down; as the jib downhaul, &c.

To dowse. To lower suddenly, or slacken.

To drag the anchor. To trail it along the bottom, after it is loosened from the ground.

To draw. When a sail is inflated by the wind, so as to advance the vessel in her course, the sail is said TO DRAW; and so TO KEEP ALL DRAWING is to inflate all the sails.

Drift. The angle which the line of a ship's motion makes with the nearest meridian, when she drives with her side to the wind and waves when laying to. It also implies the distance which the ship drives on that line.

Driver. A large sail set upon the mizen yard in light winds.

Driving. The state of being carried at random, as impelled by a storm or current. It is generally expressed of a ship when accidentally broken loose from her anchors or moorings.

Drop. Used sometimes to denote the depth of a sail; as the foretopsail DROPS twelve yards.

To drop anchor. Used synonymously with TO ANCHOR.

To drop a-stern. The ship is said to drop a-stern when, in company with others, she does not sail so fast.

To drop down a river. Is done either by backing and filling, or with the kedge anchor.

Dunnage. A quantity of loose wood, &c. laid at the bottom of a ship, to keep the goods from being damaged.

Ear-ring. A small rope fastened to a cringle in the head of the sail, for the purpose of extending it along the yard. There are Ear-rings for each reef.

To ease, to *ease away*, or to *ease off*. To slacken gradually; thus they say, EASE the bowline; EASE the sheet.

Ease the ship! The command given by the pilot to the helmsman, to put the helm a-lee, when the ship is expected to plunge her fore part deep in the water when close-hauled.

To edge away. To decline gradually from the shore or from the line of the course which the ship formerly held, in order to go more large.

To edge in with. To advance gradually towards the shore or any other object.

Elbow in the hawse. Is when a ship being moored, has gone round

hifting of the tides, twice the wrong way, so as to lay the over the other: having gone once wrong, she makes a e hawse, and going three times wrong, she makes a round

nd. A reversal of the position of any thing is turning it END. It is applied also to a rope that has run quite out of n which it was reeved, or to a cable which has all run out of

When a ship advances to a shore, rock, &c. without an ssibility of preventing her, she is said to go END ON for the

The flag worn at the stern of a ship.

port. A large port in the sides of three-deckers, leading into deck, to save the trouble of going up the ship's side to get on

l. When the keel is parallel with the horizon.

Fake. One circle of any cable or rope coiled.

The end of a rope fagged out. See WHIPPING.

l. A term for the wind when favourable to a ship's

. The channel of a narrow bay, river, or haven, in which ly advance in their passage up and down.

ny rope that passes through two or more blocks.

board of. To strike or encounter another ship when one or motion.

-stern. See DROP A-STERN.

alm. Is when there is a cessation of the wind.

own. See DROP DOWN.

To flat in. To draw in the aftermost lower corner or clue of a sail towards the middle of the ship, to give the sail a greater power to turn the vessel.

To flat in forward. To draw in the fore-sheet, jib-sheet, and fore-staysail-sheet, towards the middle of the ship.

Flaw. A sudden breeze or gust of wind.

Fleet. Above five sail of the line.

Floating. The state of being buoyed up by the water from the ground.

Flood-tide. The state of a tide when it flows or rises.

Flowing-sheets. The position of the sheets of the principal sails when they are loosened to the wind, so as to receive it into their cavities more nearly perpendicular than when close hauled, but more obliquely than when the ship sails before the wind. A ship going two or three points large has FLOWING SHEETS.

Fore. That part of a ship's frame and machinery that lies near the stem.

Fore-and-aft. Throughout the whole ship's length. Lengthways of the ship.

To fore-reach upon. To gain ground of some other ship.

Forecastle. The upper deck in the fore part of a ship.

To forge over. To force a ship violently over a shoal by a great quantity of sail.

Forward. Towards the fore part of a ship.

Foul. As FOUL WEATHER, FOUL BOTTOM, FOUL GROUND, FOUL ANCHOR, FOUL HAWSE. Opposed to FAIR, as we say FOUL WIND.

To founder. To sink at sea by filling with water.

Foxes. Two or more yarns twisted together by hand.

To free. Pumping is said to FREE the ship when it discharges more water than leaks into her.

To freshen. When a gale increases it is said to freshen.

To freshen the hawse. Veering out or heaving in a little cable to let another part of it endure the chafing in the hawse-holes. It is also applied to the act of renewing the service round the cable at the hawse-holes.

Fresh-way. When a ship increases her velocity she is said to get FRESH WAY.

Full. The situation of the sails when they are kept distended by the wind.

Full-and-by. The situation of a ship, with regard to the wind, when close-hauled; and sailing so as to steer neither too nigh the direction nor to deviate to leeward.

To furl. To wrap, or roll, a sail close up to the yard or stay to which it belongs, and winding a gasket round it to keep it fast.

Futtock-shrouds. Are shrouds which connect the lower and top mast rigging together.

Gage of the ship. Her depth of water, or what water she draws.

To gain the wind. To arrive on the weather side, or to windward, of some ship or fleet in sight, when both are sailing on a wind.

Gammon the bowsprit. Secure it by turns of a strong rope passed round it, and into the cut water, to prevent it from topping.

Gangway. The entering place into a ship.

Garboard streak. The streak nearest to the keel.

Foxes plaited together, and which they pass round the sails &c. to keep them fast when they are furled.

r. A ship is said to gather on another as she comes nearer to

A block strapt with a tail to it, on which is fixed a sheave, itched on the cable when heaving in; through the block is ove a whip, to hold on the cable.

ng. The action of turning the anchor round by the stock, motion of the stock appears similar to that of the handle of when employed to turn the wire.

The ship is girt with her cables when she is too tight moored.

hase to. To pursue a ship or fleet.

ings of a sail. The clues or lower corners of a ship's main-sail, when the middle part is furled or tied up to the yard.

g-iron. A thing in the nature of an anchor, with four or six

s. Are hatches made full of apertures.

he ship. To burn off the filth from her bottom.

a ship. That thin part of her which is fastened to the keel and joined to the false stem.

The inclination of a ship to run to windward.

the cable. Is when the cable does not coil as it ought.

ng. The laying a ship a-shore, in order to repair her. It lied to running a-ground accidentally.

tackle. Every thing belonging to a ship's anchors, and which ary for anchoring or mooring; such as cables, hawsers, tow-s, buoy-ropes, &c.

Hank-for-Hank. When two ships tack and make a progress to windward together.

Harbor. A secure place for a ship to anchor.

Hard a-lee: The situation of the helm, when pushed close to the lee side of the ship.

Hard a-weather. The situation of the helm, when pushed close to the weather side of a ship.

To haul. To pull a rope.

To haul the wind. To direct the ship's course nearer to the point from which the wind blows.

Hawse. The situation of the cables before the ship's stem, when she is moored with two anchors out from forwards. It also denotes any small distance a-head of a ship, or the space between her head and the anchors employed to ride her.

Hawse-holes. The holes in the bows of the ship through which the cables pass. Freshen hawse, veer out more cable. Clap a service in the hawse, put somewhat round the cable in the hawse hole to prevent its chafing. To clear hawse, is to untwist the cables where the ship is moored, and has got a foul hawse. Athwart hawse is to be across or before another ship's head.

Hawser. A small kind of cable.

Head-fast. A rope employed to confine the head of a ship to a wharf or some other ship.

Head-most. The situation of any ship or ships which are the most advanced in a fleet.

Head-sails. All the sails which belong to the foremast and bowsprit.

Head-sea. When the waves meet the head of a ship in her course, they are called a HEAD SEA. It is likewise applied to a large single wave coming in that direction.

Head-to-wind. The situation of a ship when her head is turned to the point from which the wind blows, as it must when tacking.

Head-way. The motion of advancing, used in opposition to STERN-WAY.

To heave. To turn about a capstern, or other machine of the like kind, by means of bars, handspikes, &c.

To heave a-head. To advance the ship by heaving in the cable or other rope fastened to an anchor at some distance before her.

To heave a-peak. To heave in the cable, till the anchor is a-peak.

To heave a-stern. To move a ship backwards by an operation similar to that of HEAVING A-HEAD.

To heave down. TO CAREEN.

To heave in the cable. To draw the cable into the ship, by turning the capstern or windlass.

To heave-in stays. To bring a ship's head to the wind, by a management of the sails and rudder, in order to get on the other tack.

To heave-out. To unfurl or loose a sail; more particularly applied to the staysails: thus we say, loose the top-sails and HEAVE OUT the staysails.

To heave short. To draw so much of the cable into the ship, as that she will be almost perpendicularly over her anchor.

To heave tight, or taut. To turn the capstern round, till the rope or cable becomes straightened.

the capstern. To turn it round with the bars.
the lead. To throw the lead overboard, in order to find the
ter.
the log. To throw the log overboard, in order to calculate
of the ship's way.
to. To stop the vessel from going forward.
dsomely. Heave gently or leisurely.
rtily. Heave strong and quick.
the sea. Is the power that the swell of the sea has upon a ship
er out, or faster on, in her course, and for which allowance
he day's work.
To stoop or incline to one side; thus they say TO HEEL TO
is, to heel to the larboard side.
he instrument by which the ship is steered, and includes
eel and the tiller, as one general term.
e! A direction to put the tiller over to the lee-side.
eather! An order to put the helm over to the windward

dry. The situation of a ship when so far run a-ground as to
upon the strand.
o make fast.
To draw up any body by the assistance of one or more
lling by means of a single block is never termed HOIST-
only the drawing of the sails upwards along the masts or

the space between the lower deck and the bottom of a ship,
er stores, &c. lie. To stow the hold, is to place the things

Jeers. The ropes by which the lower yards are suspended.

Jib. The foremost sail of a ship, set upon a boom which runs out from the bow-sprit.

Jib-boom. A spar that runs out from the bowsprit.

Jolly-boat. Smallest boat on board.

Junk. Old cable, or old rope.

Jurymast. Any spar that is set up, when the proper mast is carried away.

Keckled. Any part of a cable, covered over with old ropes, to prevent its surface from rubbing against the ship's bow or fore foot.

Kedge. A small anchor.

Keel. The principal piece of timber on which the vessel is built.

Keel-haul. To drag a person backwards and forwards under a ship's keel, for certain offences.

To keep away. To alter the ship's course to one rather more large.

To keep full. To keep the sails distended by the wind.

To keep hold of the land. To steer near to or in sight of the land.

To keep off. To sail off, or keep at a distance from the shore.

To keep the land aboard. The same as to KEEP HOLD OF THE LAND.

To keep your luff. To continue close to the wind.

To keep the wind. The same as TO KEEP YOUR LUFF.

Kentledge. What is put in the bottom of the vessel to keep the ground tier from getting wet.

Kink. Is when a rope has too much twist.

Knees. Are pieces of timber which confine the ends of the beams to the vessel's side.

Knippers. A large kind of platted rope, which, being twisted round the messenger and cable in weighing, bind them together.

Knot. A division of the log-line, answering, in the calculation of the ship's velocity, to one mile.

Knot. There are many sorts; such as overhand knot, wall knot, diamond knot, &c.

To labour. To roll or pitch heavily in a turbulent sea.

Laden in bulk. Freighted with a cargo not packed, but lying loose, as corn, salt, &c.

Laid-up. The situation of a ship when moored in a harbour, for want of employ.

Lanch-ho. Signifies to let go the top rope, when a top-mast, or top-gallant-mast, is fidded.

Land-fall. The first land discovered after a sea voyage. Thus a GOOD LAND-FALL implies the land expected or desired; a BAD LAND-FALL the reverse.

Land-locked. The situation of a ship surrounded with land, so as to exclude the prospect of the sea, unless over some intervening land.

Lanyards of the shrouds, are the small ropes at the ends of them, by which they are hove taut, or tight.

Larboard. The left side of a ship, looking towards the head.

Larboard-tack. The situation of a ship when sailing with the wind blowing upon her larboard side.

Lash. To bind.

Laying the land. A ship which increases her distance from the coast, so as to make it appear lower and smaller, is said to LAY THE LAND.

Leading-wind. A fair wind for a ship's course.

Leak. A chink or breach in the sides or bottom of a ship, through which the water enters into the hull.

To leak. To admit water into the hull through chinks or breaches in the sides or bottom.

Lee. That part of the hemisphere to which the wind is directed, to distinguish it from the other part which is called to windward.

Leeches. Are the sides of the sails.

Leechlines. Are lines which haul up the leeches to the yard.

Lee-gage. A ship or fleet to leeward of another is said to have the lee-gage.

Lee-lurches. The sudden and violent rolls which a ship often takes to leeward in a high sea; particularly when a large wave strikes her on the weather-side.

Lee of the shore. See UNDER THE LEE OF THE SHORE.

Lee-quarter. That quarter of a ship which is on the lee-side.

Lee-shore. That shore upon which the wind blows.

Lee-side. That half of a ship, lengthwise, which lies between a line drawn through the middle of her length and the side which is farthest from the point of wind.

To leeward. Towards that part of the horizon to which the wind blows.

Leeward ship. A ship that falls much to leeward of her course, when sailing close-hauled.

Leeward tide. A tide that sets to leeward.

Lee-way. The lateral movement of a ship to leeward of her course; or the angle which the line of her way makes with a line in the direction of her keel.

To lie along. To be pressed down sideways by a weight of sail in a fresh wind.

To lie to. To retard a ship in her course, by arranging the sails in such a manner as to counteract each other with nearly an equal effort, and render the ship almost immoveable, with respect to her progressive motion or headway.

Life-lines. For the preservation of the seamen; they are hitched to the topsail lift and tye blocks.

Lifts. The ropes which come to the ends of the yards from the mast heads, and by which the yards are kept square or toped.

Limbers. Holes cut in the ground timbers to let the water come to the well.

List incline. The ship has a list to port, that is, she heels to larboard.

Lizard. A bight of a small line pointed on a large one.

Log, and *Log-line.* By which the ship's path is measured, and her rate of going ascertained. Log-board, on which are marked the transactions of the ship, and from thence it is copied into the log-book every Day.

Loggerhead. A large iron ball, with a stem to it.

A long sea. A uniform motion of long waves.

Look-out. A watchful attention to some important object or event that is expected to arise. Thus persons on board of a ship are occasionally stationed to look out for signals, other ships, for land, &c

To loose. To unfurl or cast loose any sail.

To lower. To ease down gradually.

Luff! The order to the steersman to put the helm towards the lee-side of the ship, in order to sail nearer to the wind.

Magazine. A place where gunpowder is kept.

To make a board. To run a certain distance upon one tack, in beating to windward.

To make foul water. To muddy the water by running in shallow places, so that the ship's keel disturbs the mud at bottom.

To make sail. To increase the quantity of sail already set, either by unreefing, or by setting others.

To make sternway. To retreat or move with the stern foremost.

To make the land. To discover it from afar.

To make water. To leak.

To man the yards, &c. To place men on the yard, in the tops, down the ladder, &c. to execute any necessary duties.

Marline. Small line to seize blocks in their straps, &c.

Marline-spike. An instrument to splice with, &c.

Masted. Having all her masts complete.

Masts. The upright spars on which the yards and sails are set.

Maul. Large hammer to drive the fid of the topmast either in or out.

Mend the service. Put on more service.

Messenger. A small kind of cable, which being brought to the capstan, and the cable by which the ship rides made fast to it, it purchases the anchor.

To middle a rope. To double it into two equal parts.

Midships. See AMIDSHIPS.

To miss stays. A ship is said to MISS STAYS, when her head will not fly up into the direction of the wind, in order to get her on the other tack.

Mizen-peek. The after end of the gaffs.

Monkey-blocks. Are on some topsail yards, to reeve buntlines in.

Mooring. Securing a ship in a particular station by chains or cables, which are either fastened to an adjacent shore, or to anchors at the bottom.

Mooring service. When a ship is moored, and rides at one cable's length, the mooring service is that which is in the hawse hole.

Mouse. A kind of ball or knob, wrought upon the collar of the stays.

Muster. To assemble.

Narrows. A small passage between two lands.

Neap-tides. The lowest tides when the moon is at the first and third quarters.

Neaped. The situation of a ship left aground on the height of a spring-tide, so that she cannot be floated till the return of the next spring-tide.

Near, or *no near.* An order to the helmsman not to keep the ship so close to the wind.

Nothing-off. A term used by the man at the cun to the steersman, directing him not to go from the wind.

Nun-buoy. The kind of buoys used by ships of war.

Oakum. Old rope untwisted and pulled open.

Oars. What boats are rowed with.

To seaward from the land. A ship is in the offing, that is,
award, at a distance from the land. She stands for the offing,
ards the sea.

on. When a ship is beating to windward, so that by one
approaches towards the shore, and by the other stands out to
said to stand OFF-AND-ON shore.

From the shore; as when a ship lies a-ground, and leans
e sea, she is said to heel offward.

l. Within the ship; as, he is come on board.

eam. Any distance from the ship on a line with the beams,
angles with the keel.

ow. An arch of the horizon, comprehending about four
he compass on each side of that point to which the ship's
ected. Thus, they say, the ship in sight bears three points
TARBOARD-BOW; that is, three points towards the right-
that part of the horizon which is right a-head.

uarter. An arch of the horizon, comprehending about four
he compass, on each side of that point to which the ship's
ected.

The situation of a place exposed to the wind and sea. It is
sed of any distant object to which the sight or passage is not
.

wse. When the cables of a ship at her moorings lead straight
spective anchors, without crossing, she is said to ride with an
VSE.

The deck on which the cables are stowed.

rd. Out of the ship; as, he fell over-board, meaning, he
or from, the ship.

To pay off. To move a ship's head to leeward.

Peek. A stay-peek, is when the cable and the fore-stay form a line. A short peek, is when the cable is so much in as to destroy the line formed by the stay-peek. To ride with the yards a-peek, is to have them topped up by contrary lifts, so as to represent a St. Andrew's cross. They are then said to be a Portland.

Pendant. The long narrow flag worn at the mast-head by all ships of the royal navy. Brace pendants are those ropes which secure the brace-blocks to the yard-arms

Pendant broad. A broad pendant hoisted by a commodore.

Pierced. A term for gun-ports.

Pitching. The movement of a ship, by which she plunges her head and after-part alternately into the hollow of the sea.

To ply to windward. To endeavour to make a progress against the direction of the wind.

Point-blank. The direction of a gun when levelled horizontally.

Points. A number of plated ropes made fast to the sails for the purpose of reefing.

Poop. The deck next above the quarter-deck.

Pooping. The shock of a high and heavy sea upon the stern or quarter of a ship, when she scuds before the wind in a tempest.

Portland yards. Are the lower yards lowered half-way down and toped an end.

Portoise. The same as PORT LAST; TO RIDE A PORTOISE is to ride with a yard struck down to the deck.

Port. Used for larboard, or the left side; also a harbour or haven.

Port. A name given on some occasions to the larboard side of the ship; as, the ship heels to port, top the yards to port, &c.

Port the helm! The order to put the helm over to the larboard side.

Port-last. The gunwale.

Ports. The holes in the ship's sides from which the guns are fired.

Press of sail. All the sail a ship can set or carry.

Preventer. An extra rope, to assist another.

Prizing. The application of a lever to move any weighty body.

Purchase. Any sort of mechanical power employed in raising or removing heavy bodies.

Purchase. To purchase the anchor, is to loosen it out of the ground.

Pudding and dolphin. A large and lesser pad made of ropes, and put round the masts under the lower yards.

Quarters. The several stations of a ship's crew in time of action.

Quartering. When a ship under sail has the wind blowing on her quarter.

Quoil. Is a rope or cable laid up round, one fake over another.

Raft. A parcel of spars lashed together.

Raft-port. A port in a vessel's bow or stern to take in spars or timber.

To raise. To elevate any distant object at sea by approaching it: thus, TO RAISE THE LAND is used in opposition to LAY THE LAND.

To rake. To cannonade a ship at the stern or head, so that the balls scour the whole length of the decks.

Range of cable. A sufficient length of cable, drawn upon deck before the anchor is cast loose, to admit of its sinking to the bottom without any check.

Ratlines. The small ropes fastened to the shrouds, by which the men go aloft.

Reach. The distance between any two points on the banks of a river, wherein the current flows in an uninterrupted course.

Ready about! A command of the boatswain to the crew, and implies that all the hands are to be attentive, and at their stations for tacking.

Rear. The last division of a squadron, or the last squadron of a fleet. It is applied likewise to the last ship of a line, squadron, or division.

Reef. Part of a sail from one row of eyelet-holes to another. It is applied likewise to a chain of rocks lying near the surface of the water.

Reefing. The operation of reducing a sail by taking in one or more of the reefs.

Reef-bands. Pieces of canvass, about six inches wide, sewed on the fore part of sails, where the points are fixed for reefing the sail.

Reeve. To reeve a rope, is to put it through a block, and to unreeve it, is to take it out of the block.

Ribs of a ship. That is, the frame.

Rendering. The giving way or yielding to the efforts of some mechanical power. It is used in opposition to jambing or sticking.

Ride at anchor. Is when a ship is held by her anchors, and is not driven by wind or tide. To ride athwart, is to ride with the ship's side to the tide. To ride hawse-fallen, is when the water breaks into the hawse in a rough sea.

Riding. When expressed of a ship, is the state of being retained in a particular station by an anchor and cable. Thus she is said to RIDE EASY or TO RIDE HARD, in proportion to the strain upon her cable. She is likewise said to RIDE LEEWARD TIDE if anchored in a place at a time when the tide sets to leeward, and to RIDE WINDWARD TIDE if the tide sets to windward: to RIDE BETWEEN WIND AND TIDE, when the wind and tide are in direct opposition, causing her to ride without any strain upon her cables.

To rig. To put the ropes in their proper places.

Rigging. The ropes to rig with.

Rigging out a boom. The running out a pole at the end of a yard to extend the foot of a sail.

To rig the capstern. To fix the bars in their respective holes.

Righting. Restoring a ship to an upright position, either after she has been laid on a careen, or after she has been pressed down on her side by the wind.

To right the helm. Is to bring it into midships, after it has been pushed either to starboard or larboard.

Ring-ropes. Several turns round the cable and through the ring to secure the cable.

Road. A place near the land where ships may anchor, but which is not sheltered.

Robins. Small plaited yarns with eyes to fasten the sails to the yards with.

Rolling. The motion by which a ship rocks from side to side like a cradle.

Rope-yarn. Is what the cordage and cables are made with.

Rough-tree. A name applied to any mast, yard, or boom, placed in merchant-ships, or a rail or fence above the vessel's side, from the quarter-deck to the forecastle.

Round-house. A house built upon deck.

Rounding. Ropes used to put round the cable in the wake of the hawse, or stem of the ship, to keep it from rubbing or chafing the cable.

Rounding-in. The pulling upon any rope which passes through one or more blocks in a direction nearly horizontal; as, ROUND-IN the weather-braces.

Round-turn. The situation of the two cables of a ship when moored, after they have been several times crossed by the swinging of the ship.

Rounding-up. Similar to ROUNDING-IN, except that it is applied to ropes and blocks which act in a perpendicular direction.

To row. To move a boat with oars.

Rowsing. Pulling upon a cable or rope without the assistance of tackles.

Rudder. The machine by which the ship is steered.

Rullock. The nitch in a boat's side, in which the oars are used.

Run. The after-part of the vessel under water.

Runner-pennant. The first that is put over the lower masts with a block in each end.

To run out a warp. To carry the end of a rope out from a ship in a boat, and fastening it to some distant object, so that by it the ship may be removed by pulling on it.

To sag to leeward. To make considerable lee-way.

Sailing trim. Is expressed of a ship when in the best state for sailing.

Sally-port. A large port in the quarter of a fire-ship where the Captain comes out at, when he sets her on fire.

Salvage. A part of the value of a ship and cargo paid to the salvors.

Scanting. The variation of the wind, by which it becomes unfavourable to a ship's making great progress, as it deviates from being large, and obliges the vessel to steer close-hauled, or nearly so.

Scraper. A steel instrument to scrape with.

Scudd. To go right before the wind; and going in this direction without any sail set is called spooning.

Scuttle. A small cover to cover a small hole in the deck.

Scuttling. Cutting large holes through the bottom or sides of a ship, either to sink or to unlade her expeditiously when stranded.

Sea. A large wave is so called. Thus they say, A HEAVY SEA. It implies likewise the agitation of the ocean, as A GREAT SEA. It expresses the direction of the waves, as A HEAD SEA. A LONG SEA means a uniform and steady motion of long and extensive waves; a SHORT SEA, on the contrary, is when they run irregularly, broken, and interrupted.

Sea-boat. A vessel that bears the sea firmly, without straining her masts, &c.

Sea-clothes. Jackets, trowsers, &c.

Sea-mark. A point or object on shore, conspicuously seen at sea.

Seams. The joints between the planks.

Sea-room. A sufficient distance from the coast or any dangerous

that a ship may perform all nautical operations without
wreck.
bind or make fast.
The spun-yarn, marline, &c. to seaze with.
The act of pitching precipitately into the hollow between

wind something about a rope to prevent it from chafing
The service is the thing so wound about the rope.
he act of observing the situation of any distant object by

To unfurl and expand the sails to the wind, in order to
the ship.
To increase the tension of the shrouds, back-stays, &c.
niards, &c.
lower; as, SETTLE THE TOP-SAIL HALYARDS, lower

anchor. The part between the ring and the flewks.
ter. The rope by which the shank of the anchor is held
's side; is also made fast to a piece of iron chain, in which
the anchor lodges.
course. To direct or appoint the track of a ship, in order
a voyage.
e sheer of the ship is the curve that is between the head
, upon her side. The ship sheers about, that is, she goes

spars lashed together, and raised up, for the purpose of
r in a mast.

Slack-water. The interval between the flux and reflux of the tide, when no motion is perceptible in the water.

To slip the cable. To let it run quite out when there is not time to weigh the anchor.

To slue. To turn any cylindrical piece of timber about its axis without removing it. Thus, to SLUE A MAST or BOOM, is to turn it in its cap or boom-iron.

Sound. To try the depth of water; also a deep bay.

Spars. Pieces of trees as they are cut in the wood.

Spanish barton-windlass. A particular way of setting up the topmast rigging in merchant vessels.

Spear of the pump. The handle of a hand-pump.

To spill the mizen. To let go the sheet, and brail it up.

To spill. To discharge the wind out of the cavity or belly of a sail, when it is drawn up in the brails, in order to furl or reef it.

Spilling-lines. Are ropes contrived to keep the sails from being blown away, when they are clewed up, in blowing weather.

Splice. To make two ends of ropes fast together by untwisting them, and then putting the strands of one piece with the strands of the other.

Split. The state of a sail rent by the violence of the wind.

Spoon-drift. The distance she runs when scudding without any sail.

Spray. The sprinkling of a sea, driven occasionally from the top of a wave.

Spring. A spring upon the cable, is a hawser bent to the cable, outside the hawse, taken in at the most convenient part of the ship aft, for the purpose of casting her.

Spring-stays. Are rather smaller than the stays, placed above them, and intended to answer the purpose of the stay, if it should be shot away, &c.

Spring-tides. Are the tides at new and full moon, which flow highest and ebb lowest.

To spring a mast, yard, &c. To crack a mast, yard, &c. by means of straining in blowing weather, so that it is rendered unfit for use.

To spring a-leak. When a leak first commences, a ship is said to SPRING A-LEAK.

To spring the luff. A ship is said to SRING HER LUFF when she yields to the effort of the helm, by sailing nearer to the wind than before.

Spun-yarn. Two, three, or four rope-yarn twisted together.

Spur-shores. Are large pieces of timber which come abaft the pump-well.

Spurling-line. Is a line that goes round a small barrel, abaft the barrel of the wheel, and coming to the front beam of the poop-deck, moves the tell-tale with the turning of the wheel, and keeps it always in such position as to show the position of the tiller.

Squadron. Five sail of the line.

Squall. A sudden violent blast of wind.

Square. This term is applied to yards that are very long, as TAUNT is to high masts.

To square the yards. To brace the yards, so as to hang at right angles with the keel.

To stand on. To continue advancing.

To stand in. To advance towards the shore.

To stand off. To recede from the shore.

Starboard. The right-hand side of the ship, when looking forward.

Starboard-tack. A ship is said to be on the STARBOARD-TACK when sailing with the wind blowing upon her starboard side.

Starboard the helm! An order to push the helm to the starboard side.

To stay a ship. To arrange the sails, and move the rudder so as to bring the ship's head to the direction of the wind, in order to get her on the other tack.

Stay-peak. When the cable makes the same angle as the stay does.

Stays. Large ropes coming from the mast heads down before the masts, to prevent them from springing, when the ship is sending deep.

Steady! The order to the helmsman to keep the ship in the direction she is going at that instant.

Steady. In sailing, is when she is going her right course off the wind.

Steady the ship. That is by running a rope or towling out on either side when at anchor.

Steering. The art of directing the ship's way by the movement of the helm.

Steerage-way. Such degree of progressive motion of a ship as will give effect to the motion of the helm.

Steeve. Turning up. The bowsprit steeves too much, that is, it is too upright.

To stem the tide. When a ship is sailing against the tide at such a rate as enables her to overcome its power, she is said to STEM THE TIDE.

Stem. The fore-part of the vessel.

Stern. The after-part of the vessel.

Sternfast. A rope confining a ship by her stern to any other ship or wharf.

Sternmost. The farthest a-stern, opposed to HEADMOST.

Sternway. The motion by which a ship falls back with her stern foremost.

Stiff. The condition of a ship when she will carry a great quantity of sail without hazard of oversetting. It is used in opposition to CRANK.

Stirrup. A piece of rope; one end nailed to the yard, in the other a thimble for the horse to reave in.

Stoppers. Large kind of ropes, which being fastened to the cable in different places abaft the bitts, are an additional security to the ship at anchor.

To stow. To arrange and dispose a ship's cargo.

Strand. One third part of a three-strand rope.

Stranded. When a vessel is got aground on some rocks, and filled with water.

To stream the buoy. To let it fall from the ship's side into the water, previously to casting anchor.

Stretch-out. A term used to the men in a boat, when they should pull strong.

To strike. To lower or let down any thing. Used emphatically to denote the lowering of colours in token of surrender to a victorious enemy.

To strike soundings. To touch ground with the lead, when endeavouring to find the depth of water.

Strops. Either rope or iron, which are fixed to blocks or dead eyes to attach them to any thing.

Sued or *Sewed.* When a ship is on shore, and the water leaves her, she is said to be sued; if the water leaves her two feet, she sues, or is sued, two feet.

Surf. The swell of the sea that breaks upon the shore, or on any rock.

To surge the capstern. To slacken the rope heaved round upon it.

Sway. The same as Hoist.

Sway away. Hoist, used in getting up masts or yards.

Swab. A kind of large mop, made of junk, to clean a ship's deck with.

Swell. The fluctuating motion of the sea either during or after a storm.

Sweeping. The act of dragging the bight or loose part of a rope along the surface of the ground, in a harbour or road, in order to drag up something lost.

Swift the capstern bars. Is to confine the outward end of the bars one to another, with a rope.

Swinging. The act of a ship's turning round her anchor at the change of wind or tide.

To tack. To turn a ship about from one tack to another, by bringing her head to the wind.

Taking-in. The act of furling the sails. Used in opposition to SETTING.

Taken a-back. See A-back.

Tarpaulin. A cloth of canvass covered with tar and saw-dust, or some other composition, so as to make it water-proof.

Taut. Improperly, though very generally, used for TIGHT.

Taunt. High or tall. Particularly applied to masts of extraordinary length.

Tell-tale. An instrument which traverses upon an index in the front of the poop deck, to show the position of the tiller.

Tending. The turning, or swinging, of a ship round her anchor in a tide-way at the beginning of ebb and flood.

Thwart. See A-THWART.

Thwart-ships. See A-THWART SHIPS.

Thus! An order to the helmsman to keep the ship in her present situation, when sailing with a scant wind.

Tide-way. That part of a river in which the tide ebbs and flows strongly.

Tier. A row; as cable-tier, a tier of guns, casks, or a tier of ships, &c.

Tide-gate. A place where the tide runs strong.

Tide it up. To go with the tide against the wind.

Timbers. What the frame is composed of.

Tiller. A large piece of wood, or beam, put into the head of the rudder, and by means of which the rudder is moved.

Tompion, or *Tomkin.* The bung, or piece of wood, by which the mouth of the cannon is filled to keep out wet.

Topping. Pulling one of the ends of a yard higher than the other.

To tow. To draw a ship in the water by a rope fixed to a boat or other ship which is rowing or sailing on.

Tow-line. A small line cable laid.

Transom. A large piece of timber fastened to the stern-posts, to the ends of which the afterpart of the bends are fastened.

Traverse. To go backwards and forwards.

Traveller. A ring on the jib boom, or grumet on the backstays, to conduct the top-gallant yards up and down.

Trey-sail. A small sail used by brigs and cutters in blowing weather.

Trice, trice up. To haul up and fasten.

Trim. The state or disposition by which a ship is best calculated for the purposes of navigation.

To trim the hold. To arrange the cargo regularly.

To trim the sails. To dispose the sails in the best arrangement for the course which a ship is steering.

To trip the anchor. To loosen the anchor from the ground, either by design or accident.

Trough of the sea. The hollow between two waves.

Truck of a gun-carriage. Is the wheel upon which it runs.

Truck. A round piece of wood put on the top of flag staffs, with sheaves on each side for the halyards of the flags to reeve in.

Trunnions of a gun. Are the arms, or pieces of iron, by which it hangs on the carriage.

Trunnels. Pieces of timber to fasten the plank to the timbers.

Trying. The situation in which a ship, in a tempest, lies-to in the trough or hollow of the sea, particularly when the wind blows contrary to her course.

Turning to windward. That operation in sailing whereby a ship endeavours to advance against the wind.

Van. The foremost division of a fleet in one line. It is likewise applied to the foremost ship of a division.

Vane. A small kind of flag worn at each mast head.

To veer. To change a ship's course from one tack to the other, by turning her stern to windward.

Veer. Let out; as veer away the cable.

Veer. Shift. The wind veers, that is, it shifts or changes.

Viol, or *Voyal.* A block through which the messenger passes in weighing the anchor. A large messenger is called a viol.

To unballast. To discharge the ballast out of a ship.

To unbend. To take the sails off from their yards and stays. To cast loose the anchor from the cable. To untie two ropes.

To unbit. To remove the turns of the cable from off the bits.

Under-foot. Is expressed of an anchor that is directly under the ship.

Under-sail. When a ship is loosened from moorings, and is under the government of her sails and rudder.

Under-way. The same as UNDER SAIL.

Under the lee of the shore. Is to be close under the shore which lies to windward of the ship.

Unfurl. Cast loose the gasket of the sails.

To unmoor. To reduce a ship to the state of riding at single anchor, after she has been moored.

To unreeve. To draw a rope from out of a block, thimble, &c.

To unrig. To deprive the ship of her rigging.

Uvrou. The piece of wood by which the legs of the crow-foot are extended.

Wake. The path or track impressed on the water by the ship's passing through it, leaving a smoothness in the sea behind it. A ship is said to come into the wake of another when she follows her in the same track, and is chiefly done in bringing ships to, or in forming the line of battle.

Wales. Are strong timbers that go round a ship a little above her water-line.

Ware. See To VEER.

Warp. To warp a ship, is to draw her against the wind, &c. by means of anchors and hawsers carried out.

Warp. A hawser, or small cable.

Water-line. The line made by the water's edge when a ship has her full proportion of stores, &c. on board.

Water-borne. The state of a ship when there is barely a sufficient depth of water to float her off from the ground.

Water-logged. The state of a ship become heavy and inactive on the sea, from the great quantity of water leaked into her.

Water-tight. The state of a ship when not leaky.

Weather. To weather any thing, is to go to windward of it.

Weather-beaten. Shattered by a storm.

Weather-bit. A turn of the cable about the end of the windlass.

Weather-gage. When a ship or fleet is to windward of another, she is said to have the WEATHER-GAGE of her.

Weather-quarter. That quarter of the ship which is on the windward side.

Weather-side. The side upon which the wind blows.

To weigh anchor. To heave up an anchor from the bottom.

Whipping. To bind twine round the ends of ropes, to hinder them from fagging out.

To wind a ship. To change her position, bringing her head where her stern was.

Wind-rode. When a ship is at anchor, and the wind, being against the tide, is so strong as to overcome its power, and keep the ship to leeward of her anchor, she is said to be WIND-RODE.

Wind's eye. The point from which the wind blows.

To windward. Towards that part of the horizon from which the wind blows.

Windward tide. A tide that sets to windward.

To work a ship. To direct the movements of a ship, by adapting the sails, and managing the rudder, according to the course the ship has to make.

To work to windward. To make a progress against the direction of the wind.

Would. To would, is to bind round with ropes; as, the mast is woulded.

Weigh. To haul up; as, weigh the anchor.

Yawing. The motion of a ship when she deviates from her course to the right or left.

Yards. The timbers upon which the sails are spread.

Yarn. See ROPE YARN.

EXPLANATION of the PLATE describing the RIGGING, &c. of a FIRST-RATE MAN OF WAR.

1 BOWSPRIT
2 Gammoning
3 Cap
4 Bobstay
5 Manrope
6 Spritsail yard
7 Lifts
8 Standing lifts
9 Horses
10 Parrel
11 Braces and pendants
12 Sheets and pendants
13 Clewlines
14 Buntlines
15 Jib-boom
16 Traveller
17 Horse
18 Stay
19 Halyards
20 Guy
21 Jack-staff
22 Truck
23 Jack flag

Fore, main, and mizen-mast, rigged alike, as on the top-mast and top-gallant mast, and all the yards, except the cross-jack yard, which has no sail; therefore the description of one serves for the other, except where otherways expressed.

24 Foremast
25 Woulding
26 Fish
27 Top
28 Cap
29 Runner and tackle
30 Shrouds
31 Lanyards
32 Ratlines
33 Stay and lanyard
34 Spring stay and ditto
35 Snakeline
36 Crowfoot
37 Fore yard
38 Geers
39 Lifts
40 Braces and pendants
41 Clewlines
42 Buntlines
43 Horses and stirrups
44 Leechlines
45 Yard tackles
46 Bowlines and bridles
47 Tacks
48 Sheets
49 Truss parrel
50 Podding
51 Dolphin
52 Toprope
53 Topmast
54 Crosstrees
55 Cap
56 Runner
57 Shrouds and lanyards
58 Stays
59 Backstays
60 Staysail halyards
61 Topsail yard
62 Tye and halyard
63 Lifts
64 Braces and pendants
65 Horses
66 Parrel
67 Flemish horse
68 Buntlines
69 Clewlines
70 Bowlines and bridles
71 Reef tackles and pendants
72 Jewel blocks
73 Sheets
74 Top-gallant mast
75 Shrouds
76 Stay
77 Backstay
78 Top-gallant yard
79 Halyard
80 Lifts
81 Horse
82 Parrel
83 Clewline
84 Bowline
85 Sheet
86 Royal mast
87 Stay
88 Backstay
89 Truck
90 Admiralty flag
91 Middle-stay-sail stay
92 Halyards
93 Top-gal. stay-sail halyards
94 Mizen gaff
95 Derrick and span
96 Peek brails
97 Spanker halyards
98 Vangs
99 Cross-jack yard
100 Spanker boom
101 Topin lift
102 Poop lanthorn
103 Stern ladder
104 Rudder chains
105 Standard flag
106 Union flag
107 Ensign staff
108 Ensign flag
109 Futtock-shrouds
110 Cable

HULL.

A Head or stem
B Forecastle
C Waist
D Quarter-deck
E Poop
F Stern or [illegible]

A FIRST RATE SHIP OF WAR.

The following Questions and Answers are recommended to the perusal of young Gentlemen belonging to the Sea, in order to refresh their Memories, previous to that Examination which they must pass through, before they are appointed to a Commission in the Royal Navy, or an Officer in the East India Service; as it is probable similar ones may be asked by those appointed to examine them, at the Navy Office and the East-India House.

Quest. HOW do you find the golden number?

A. I add one to the given year, and divide the sum by 19, the remainder will be the golden number.

Q. How do you find the epact for any year?

A. By dividing the given year by 19, and multiplying the remainder by 11, the product will be the epact, if it does not exceed 30; but if it does, I subtract 30 from it as often as I can, and the remainder will be the epact.

Q. How do you find the moon's age?

A. To the epact I add the day of the month, and the number of the month; their sum will be the moon's age, if it does not exceed 30; but if it does, I subtract 30 from it as often as I can, and the remainder will be her age.

Q. How do you find the moon's southing, or the time of her coming to the meridian?

A. I multiply the moon's age by 48, and divide the product by 60: the quotient will be the hours, and the remainder the minutes when she is on the meridian past noon: Or, I may multiply the moon's age by 4, and divide the product by 5, the quotient will be the hours, and the remainder, multiplied by 12, will be the minutes when she souths, or is on the meridian, in the afternoon: but if this time should exceed 12, I subtract 12 from it, and the remainder will be the time of her southing in the morning.

Q. How do you find the time of high-water at any place?

A. To the moon's southing on the given day, I add the time of high water, full and change, at the given place, and the sum will be the time of high-water there in the afternoon; but if this time should exceed 12, I subtract 12 from it, and the remainder will be the time of high-water in the morning; and if it exceeds 24, I subtract 24 from it, and the remainder will be the time of high-water in the afternoon*.

Q. Suppose that you go into a harbour, and find by your watch that it is high-water at any hour of the day; by what means do you find the times when it is high-water on full and change days in that place?

A. I find the time of the moon's southing on that day, and subtract it from the time of high-water at the given place, if I can, and that will be the time of high-water. If I cannot, I add 12 to it, and then subtract the above time; the remainder will be the time of high-water at the given place, on full and change days.

Q. How do you find the zenith distance of any object?

A. By correcting the altitude for the dip, refraction and semidiameter,

* *The time of high-water is found more correct by the Tables, see page 128, and 130.*

and then subtracting it from 90°, the remainder will be the zenith distance, which will be either north or south, according as the object bears of me.

Q. Suppose the zenith distance 10° north, and the declination 20° north, what latitude are you in, and of what name?

A. Ten degrees north.

Q. The sun is in your zenith, what latitude are you in?

A. The same as the declination is, whether north or south.

Q. Your zenith distance is 20° north, and your declination is 20° north, what latitude are you in?

A. Upon the equator, and consequently in no latitude.

Q. Suppose that your zenith distance is 50° south, and the declination 10° north, what latitude are you in?

A. Sixty degrees north.

Q. Suppose your zenith distance be 45° north, and the declination 15° south, what latitude are you in?

A. Sixty degrees south.

Q. Suppose your zenith distance is 45° north, and the declination 15 north, what latitude are you in?

A. Thirty degrees south.

Q. What do you mean by the word amplitude?

A. The true amplitude is the number of degrees that the sun, moon, or stars, rise and set, to the northward or southward of the true east or west. The magnetic amplitude is the number of degrees they rise or set to the northward or southward of the east or west point of the compass.

Q. How do you find the true amplitude?

A. As the co-sine of the latitude: is to the radius : : so is the sine of the sun or star's declination : to the sine of the true amplitude. Or

Q. You have given the true amplitude or azimuth by calculation, and the magnetic amplitude or azimuth by observation; how do you find the variation?

A. By placing both the amplitudes or azimuths before me; then, if the true amplitude or azimuth be to the right hand of the magnetic, or observed, the variation is east, but if it be to the left hand, it is west.

Q. You have the latitude and longitude the ship is in, consequently her place, how do you shape her course, or in other words find her course and distance to any other place, whose latitude and longitude is known?

A. It may be found briefly by the tables of difference of latitude and departure, but by logarithms I will say,

As the meridional difference of latitude: is to radius : : so is the difference of longitude: to the tangent of the course. And,

As the co-sine of the course: is to the proper difference of latitude : : so is radius : to the distance.

Q. You have the difference of latitude and departure made good in the 24 hours, how do you find the course and distance, and the ship's place by logarithms?

A. As the difference of latitude : is to radius : : so is the departure : to the tangent of the course. And,

As the co-sine of the course : is to the difference of latitude : : so is radius : to the distance made good in the 24 hours.

Having the latitude and longitude left, and the difference of latitude, I find the latitude in, and the meridional difference of latitude; I then say,

As the co-sine of the course : is to the meridional difference of latitude : : so is the sine of the course : to the difference of longitude. Or, as the proper difference of latitude: is to the departure : : so is the meridional difference of latitude : to the difference of longitude. Having the longitude left, and the difference, the longitude in is found by addition or subtraction, as the case requires.

Q. You have now the ship's place by calculation, how do you find it on a Mercator's chart?

A. By laying a ruler across the chart on the ship's latitude, and taking her longitude in my compasses, and setting one point on the meridian, by the side of the ruler, I turn the other east or west, according as the longitude is (by the side of the ruler), and it will point out the ship's place.

Q. You have now the ship's place, how do you find her bearing and distance to any other known place?

A. By laying a ruler over the point where the ship is, and the given place, and with the compasses I take the nearest distance between the ruler and the centre of some compass on the chart; and slide the compassesal ong the ruler (keeping both points perpendicular to it) the farthest point from the ruler will show the course, or bearing, between the ship and place. Again,

I take the distance between the ship and place in the compasses, and then lay one point on the meridian as much below the ship's place, as the other is above the given place; that distance, reckoned in degrees, leagues, or miles, on the meridian, according as it is divided, will be the distance.

Q. You are ordered to a ship, she is lying in dock; prepare to take her out of dock.

A. I would take on board what kentledge was necessary, stream anchor and cable, kedge anchor, hawser and towline, with some spare ropes for guys, to keep her fair for the dock gates; buoy and buoy ropes for stream and kedge.

Q. When your ship is out of dock, what is first to be done?

A. I would secure her, then take on board the remainder of the kentledge, and level the hold, by laying the kentledge from the fore part of the fore hatchway to the after-part of the after hatchway.

Q. If you are taking in bales, how would you dunnage, and which part of the ship most?

A. I would dunnage six inches, and mostly about the pump well, main hatchway, the wake of the chains and floor timber heads.

Q. Suppose you have one and a half foot water in your hold, and your ship heels four streaks; what dunnage ought you to have to preserve the cargo?

A. Three feet.

Q. How would you moor your ship at Gravesend?

A. I would come-to with my small bower, veer the service into the hawse, and then hang my best bower anchor to the long boat, and with the tide drop her a-stern: when the cable is taut, let go the anchor, first letting go the shank rope, to keep the cable more taut.

Q. How would you hang the anchor to the long boat?

A. Take the buoy-rope over the roller (which is in the middle of the stern of the long boat), bring the bight round the main thwart, cockbill the anchor, hook the cat to the anchor, and lower away, until the flukes of the anchor are clear of the boat's bottom, then make fast the buoy-rope, have a shank-rope through the ring (which is at the boat's stern-

at half ebb, that I might have time to stow my best bower, and shorten in my small bower cable, before the ship tends to windward.

Q. Proceed to unmoor ship as it is done in the navy.

A. I would send for the master to see the hawse is clear, turn all hands up to unmoor ship, lay the capstan bars for shipping, call the mate to see the messenger passed for the best bower, rig the davit out, because I will take it up the first quarter flood, get the cat and fish to pass for the best bower, stretch along the fish-tackle: quarter-masters down in the tier, and stand by to veer away the small bower cable; ship the capstan bars, pin and swift them; clap on the stoppers before the bitts, and bring to the messenger. At the same time unbit the best bower, rowse aft the slack cable; heave taut, take off the stoppers, hold on the messenger, and heave away; veer away the small bower cable; clap on the nippers. Thick and dry for weighing, heave cheerly; the anchor's away, keep fast the small bower cable; quarter-master take hold of the helm; look out for the anchor; the anchor is in sight; heave and paul the capstan; hook the cat; haul taut, and take a turn; surge the messenger round the capstan; take off the nippers; out cable; cable enough; haul cat; belay the catfall; pass the stopper; hook the fish; try fish by hand; haul with the fish: belay the fish-tackle fall; pass the shank painter; bowse to the stock with the tackle; belay the shank-painter; make fast the stopper and stock lashing; come up cat and fish; unhook both; haul the buoy and buoy rope in; then shift the messenger for the small bower and bring to, clap on the stoppers before the bitts, and unbit the cable; rowse aft the slack cable; man the capstan; hold on the messenger; forecastle-men rig out the davit for the small bower: when the anchor is a stay peek, send the top men to loose the sails; man the yards; stretch along the topsail sheets; let fall the topsails; overhaul reef tackles, bunt-lines and clue-lines; foot the sails out of the top; haul home the topsail-sheet; stretch along the topsail-halyards and man them; quarter-master and boatswain's mates attend to the braces; hoist away the topsails; topsails atrip: belay the halyards; trim the sails; heave up the anchor; stow it as before, and haul the buoy and buoy rope in.

Q. How would you unmoor with the wind S. E. or S.?

A. Veer on the best bower cable, and take the small bower-anchor up first; and proceed as before, then heave in to the short service on the best bower, &c. If the anchor has great hold and afraid of standing the messenger, clear away the main capstan and lash a block, or purchase blocks, on the cable, and one to the main-mast, or one to the two ports abreast of the main-mast; reeve a hawser through them, and heave on both capstans together.

Q. Suppose you are close upon a wind, in moderate weather, with all your sails set, how will you tack the ship?

A. I would stretch along the lee bow-lines, and weather-braces, the weather-sheets and lee-tacks; then put the helm a-lee, let go the fore sheet, lee fore-top sail, brace and fore-top bow-line; jib and stay-sail sheets. When the fore-top sail touches, brace to and help her; when aback, brace up and help her; when the wind is out of the after sails, raise tacks and sheets; shift the stay-sail tacks, and haul over the stay-sail sheets; when the wind is rather ½ a point on the bow, if sure of *coming about, haul* the main sail. N. B. One watch of the top-men *on the quarter-deck* and fore castle, to set up the weather-breast back-

stays. If she has stern way, shift the helm and top the sprit-sail yard: haul on board the main tack and aft the main sheet. Brace up the main yard when the after sails are full; haul off all; and haul on board the fore tack; keep in the weather braces forward, and let her come to, then brace up; haul aft the fore-sheet, jib and stay sail sheets (set up the back-stays when the ship is head to wind), and haul the bow-lines; then haul taut the weather-braces, lee-tacks, and weather-sheets; have the braces let go at once; when the word is given to haul mainsail, (all the hands on the braces should keep hauling taut in for the run) the yards will swing of themselves.

Q. How would you tack a ship under her three top-sails?

A. I would put the helm a-lee, ease off the fore-top sail brace, keep fast the fore top bowline; when the top-sail touches, brace to and help her; when the wind is a-head, haul the main top-sail and shift the helm: then brace up the main yard, and haul the main-top bowline: when the after-sails are full, let go and haul; keep in the weather-braces forward, and when she comes to brace sharp up, haul the main and fore-top bowlines, haul taut the weather braces, and top the sprit-sail yard.

Q. How do you veer, or wear a ship, with all her sails set?

A. I would haul the mizen up, and the mizen stay-sail down, or brail it up, hard a weather the helm, shiver the mizen top-sail, let go the main and main-top bowlines, ease off the main sheet, the lee main brace, and round in the weather brace. When the wind is abaft the beam, raise the main tack; when the wind is aft, square the head yards, and get the other tacks on board; haul aft the sheets, shift the jib and stay-sail sheets over the stays, and as she comes to, haul the mizen out; hoist

out the reef-tackles, haul in the weather-brace, steady the lee-brace, haul taut the top-sail halyards; send the people up to hand the sail, and when up, before they go on the yard, I'll clap the rolling tackle on to steady it, and a piece of canvass abreast of the lee top-mast shrouds after the sail is handed, (all the top sails should be taken in the same way); after that, if squally, take in the main top-sail, and then the ship is under her courses.

Q. How would you veer a ship under her courses?

A. I would haul the mizen and main-sail up, and down mizen stay-sail, square the after yards, hard a weather the helm, man the weather fore-brace, and ease off the lee-brace and fore bowline; ease off the fore-tack, and haul on board the other: keep her large, if room, until I get the tack on board and belay it: then luff up to the wind, haul aft the fore-sheet and brace up the fore-yard, set the after-sails, aboard maintack, aft the main sheet, brace all up, and haul the bowlines; when my sails are trimmed, shift the rolling tackles on the top-sail yards.

Q. Suppose you are lying to in a hard gale of wind, under a reef main-sail, you want the ship's head on the other tack; how will you veer in a great sea?

A. I will watch her falling off, and put the helm a-weather, when she does, ease off the main sheet; if that will not do, I'll man the fore-shrouds, and get tarpaulins and hammocks or spare canvass up, and spread it. If that will not do, I will haul aft the main sheet, and put the helm a-lee, then send hands out to the sprit-sail yard with hammocks and gaskets to stop the sprit-sail (called balancing) within the lee clew-line; block and loose the lee yard-arm, then haul aft the sheet, clap the helm hard a-weather, ease off the main sheet, round in the weather-brace, gather aft the other sheet, haul the main tack on board; when she is before the wind, square the sprit-sail yard, clue the sail up and furl it; ease the helm down a-lee, brace the yards up, haul the main sheet aft, bowse the bowline up, lash the helm three parts a-lee, and she will lay to as before.

Q. Suppose she will not veer after all you have done?

A. I will loose the goose-wings of the fore-sail; if that will not do, set the fore-sail and veer her under her courses, or haul the main-sail up; if by hauling the main-sail up and furling it she does not veer, lower down the mizen yard; if that will not do, lower down the cross-jack yard and mizen top-mast; if that will not do, cut away the mizen-mast.

Q. How do you cast a ship, when intending to get under way?

A. If I am to cast her to starboard, I would haul in my larboard braces forward, and let my after yards lay square; I may hoist the fore top mast stay-sail, and keep the sheet to windward to help her. If I am to cast her to port, I would haul in the contrary braces, when cast, fill the head sails and brace up as circumstances require. *N. B.* If a ship is wind-rode, as soon as the anchor is right up and down, put the helm the way you would have her cast, setting in the same braces abaft, and the contrary forward: but if she is tide-rode, the helm must be put the contrary way to which you would have her cast, and set in the braces forward; which ever way the helm is, the braces abaft must be the contrary.

Q. It blows hard, and you split your top-sail?

A. I would let go the bowline, haul in the weather-brace, and lower away the halyards, clew up the lee-sheet, haul up the bunt-lines, start

ie weather-sheet, belay the clue-lines and bunt-lines, unbend the sail, end another; then either furl or set it, as circumstances require.

Q. You are lying to in a hard gale of wind, and split your main-sail?

A. I will haul it up carefully, unbend the sail, and bend another, get ı board the main tack, and haul aft the sheet; when the sail is set, :t a tackle on the weather-leech to secure the tack, and a preventer ieet: but in small ships they get the lee tack aft for a preventer sheet.

Q. Suppose you are on a wind, and let the ship come up in the wind, ıd are all aback, what will you do?

A. I will box her off, and suppose she will not box off, I will haul the izen up, let go the main and main-top bow-lines, the lee main and main-p-sail braces, and lay all square abaft, put the helm to leeward, if she ıs stern-way, when the wind is abaft the beam shift the helm; and, as e gets head-way, haul in a little of the after-braces, haul the mizen out, ace up sharp abaft and haul the bow-lines; and then I am on the same ck as before.

Q. Suppose you are on a wind, close upon the land, and standing on ust run on shore, and you can clear the land on the other tack; but it ows hard and a head swell, that she will not stay: and should you er you would be on shore, how would you get upon the other tack?

A. I would club-haul her; this is done by putting the helm a-lee, and ting go the lee-anchor, and bringing her head up to wind; then cut e cable and haul about the after-sails; and when they are full brace out the head-sails, haul on board the fore-tack, and brace up the other ty.

Q. If by accident your ship is brought by the lee, what would you do?

A. When a ship is brought by the lee, it is commonly occasioned by arge sea, and by the neglect of the helmsman. When the wind is two or ree points on the quarter, the ship taking a lurch brings the wind on e other side, and lays the sails all dead to the mast; as the yards are aced up, she then having little way, and the helm being of little service, would therefore brace about the head-sails the other way, and keep the ain-top-sail shivering; when she gathers way, and brings the wind aft ain, raise the fore-tack and square the head-sails; trim the sails as they

second cable of the best bower; being all clear, I'll set my foresail and steer in for the Sound, and when I am near the place I intend to anchor in, I'll man the fore clue garnets, and stand by to lower the yards and top-masts: being ready, lower away, haul the fore-sail close up, and furl it a Portland, clap rolling tackles on the lower yards, and heel ropes on the top-masts; having the marks on to anchor, stream the best bower buoy, and see that it goes clear of the ship, and when I intend to bring up, put the helm down, and haul the mizen out, then let go the anchor and veer away at least one and a half cable before I check her; should the ship drive with two cables out, on the best bower, stream the small bower-buoy and let go the anchor, which will allow me to veer a cable on the small bower; this will bring her up if it blows ever so hard, and I have still the sheet anchor to stand by; when I have brought up, and double-bitted and stoppered the cables, I'll get the top-sail yards fore and aft in the tops, and make the ship as snug as possible; as soon as the gale is over, get the anchors up and moor properly. The best method is to unbend the small bower buoy-rope from the anchor, it being liable to get foul of the best bower cable, by the buoy going over and over again of the said cable, which has been often the case. *N. B.* In coming from the westward with a hard gale of wind, and bound into the Downs, take the same method.

Q. Suppose you are on a lee shore, and had neither room to veer or stay, nor any anchoring ground, how would you put the ship's head round the other way?

A. I would put my helm hard a-lee; when she comes head to wind, raise the fore and main tacks directly, make a run with my weather braces and lay all aback at once, then haul forward my lee-tacks and bow-lines as far as I can, that the ship may fall round on her heel, and when the main-sail begins to shiver, I would haul it up, fill my head sails, and shift the helm hard a-weather; when the wind comes on the other quarter, haul on board the main tack, and bring her close to the wind.

Q. Suppose it blows hard, you cannot carry your courses, night coming on, and it is likely to blow harder, what will you do?

A. I will haul the fore-sail up and furl it, balance the mizen, haul it out to keep her to, then haul up the weather main clue-garnet and bunt-line, then the lee clue-garnet bunt-lines and leech-lines, square the yards, and get strops round the mast above the booms to hook the yard tackles to for rolling tackles, then reef the sail; when reefed, haul on board the tack, get aft the sheet handsomely, tend the braces, bowse up the bow-line, and haul up the mizen.

Q. You are just abreast of Portland, coming up Channel, the wind has taken you back; you have all sails set, and you have no time to take them in, for you will be on shore or in the Race presently, how will you proceed?

A. If she has head-way, I will put the helm a-port, let go the fore sheet and larboard braces; as soon as the after-sails shiver, haul down all the studding-sails; if it blows fresh take in top-gallant sails, brace up the after-yards; when full, brace up forward, and haul on board the fore-tack, trim all sharp, and haul the bow-lines, and then haul taut the weather-braces.

Q. Suppose you are turning over the Flats with your top-sails and fore-sail, you endeavour to put about, but she will not stay, there is a sand a-head, *within a cable's length* of you, what will you do?

A. I will heave all aback, when she has paid well off, shift the helm; *brace about the head-sails* and shiver the after-sails; then she will veer

Q. You are in a gale of wind, and split your fore-course, what will you do?

A. I'll man the weather fore clue-garnet, bunt-lines and leech-lines, ease off the fore-tack, and when clued up, man the lee clue-garnet and haul it close up; let go the lee-brace; when I let go the sheet and square the yard, haul taut the lifts and braces, send hands to unbend the sail; when another is bent, and I want to set it, I will haul on board the fore-tack, and haul aft the fore-sheet, brace the yard up and haul the bow-line.

Q. It blows hard, and you want to reef your courses, how would you proceed?

A. I will let go the top-sail sheets and lifts, man the down-haul tackles, lower away the jeers, let go the bow-lines and clue the sails up, round in the weather-braces, haul taut the lifts, braces, and rolling tackles; then send hands up to reef the sails; when I want to set them, I will proceed with the sails as before.

Q. Suppose it blows hard at S. W. and you are drove from your anchors in the Downs, what would you do?

A. I would steer for the Gull-stream, which I shall know by having the upper Light on the South Foreland to bear S. W. by S.; then steer away between the N. E. and N. E. by N. which will carry me between the Brake and the Goodwin Sands, keeping to the Goodwin in nine or ten fathom, and to the Brake in seven or six.

Q. You are standing on a wind with all your sails set; your enemy is in sight, standing towards you, how do you clear your ship for action?

A. I will call all hands to quarters, up hammocks, the quarter-masters to stow them in the netting, and on the gang-way; get the top-

A. Because the mast will go a-stern clear of the rudder, and prevent its damaging the ship.

Q. You are going large and see a ship in the wind's eye, how will you proceed to chase her?

A. I will turn all hands up, get my tacks on board, brace up my yards and haul aft the sheets; haul the bowlines, set the jib and stay-sails, keep her full, and by making short boards and turn directly to windward, which will prevent her putting away large.

Q. Suppose you were to carry away your bowsprit, what would you do?

A. I would immediately veer ship, and keep her before the wind; and then, for the security of the fore-mast, I would carry forward the fore-runners and tackles, and bowse them well taut, till I can get a hawser or sufficient rope, and clinch it round the mast-head, and secure it to the bits of the forecastle or the cat-heads; then take the best spar I have and make a jury bowsprit of it.

Q. Having a fair wind, how will you set your fore-top-mast studding sail on the larboard side?

A. First haul taut the truss tackles, and bowse the fore-yard close to; then haul taut the larboard fore-lift, and starboard fore-top-sail clue-line; on board his majesty's ships the top burtons are on the top-sail yards to keep them square when studding-sails are set (the top-sails, lifts, and clue-lines not thought of): the fore-top men down on the fore-yard, and rig out the larboard studding-sail boom, first sending down the studding-sail tack and outer halyards; up to the fore-top-sail larboard yard-arm, and reeve the halyards, send them down and bend them; the tack being bent and all ready, man the halyards and hoist away, haul out the tack, &c. If the wind is on the beam or quartering, set it abaft the top-sail; if right aft, before the top-sail, (which is done by a man standing on the fore yard-arm, with the leach of the studding-sail in his hands).

Q. Suppose you are in an engagement, and your main-top-mast stay is shot away, how will you secure your mast?

A. I will send my shifting back-stay forward by the main-top-mast stay-sail halyards, and reeve it through a block abaft the fore-mast head, bowse it taut, and that will secure the mast.

Q. Your ship comes to against her helm, what will you do?

A. I will haul my mizen up, and shiver the after-sails.

Q. She comes to yet, if she stays she will be on board some other ship?

A. I'll let go the lee fore and fore-top-sail braces, raise the fore tack and let go the bow-lines, haul in the weather braces, and box her off.

Q. How do you splice your cables?

A. I will put the whole strands of the best or small bower cables twice each way, and point each strand with a tail of three fathoms each; then seize them with quarter and end seizing to make them lie snug, which is the readiest way for clearing the hawse, they being soon spliced and unspliced when pointed.

Q. How would you mark the lead-line?

A. Black leather at 2 and 3 fathoms, white at 5, red at 7, black at 10, white at 13, (some seamen use black at 10 and 15) white at 15 as at 5, red at 17 as at 7, two knots at 20 fathoms, and so on, an additional knot at every 10 fathoms, with a single knot between each 10 fathoms to mark the line at every 5 fathoms.

Q. You are sent down in the dark for a top-sail, how do you know a main-sail from a fore-sail, or a main-top-sail from a fore-top-sail?

it is a fore-sail: if it is marled abaft the foot rope, it is a main-sail; if before, it is a fore-sail: if a main-top-sail, it has four bow-line cringles, if a fore top-sail but three: all top-sails are marled to the rope, because the foot rope is served.

Q. The sheers are along side, how do you get them in?

A. Par-buckle them in with their heads aft on the poop, and get the fore and main runners on them for guys; lash on two four-fold blocks, reeve the masting-falls, get girt lines on the head of the sheers to steady the mast-head, put heel lashings on the sheers, with good oak planks under them, to transport them forward on; lash one of the four-fold blocks forward to the stem, and bring the fall to the capstan; heave the sheers high enough: when done, I'll take forward two runners and tackles to assist the sheers, take the mizen-mast first in, then raise the sheers erect, take in the main-mast, bowse the heels of the sheers forward, and keep them upright to take in the foremast.

Q. How do you rig a lower mast?

A. I will lash on the girt-line-blocks, put on the bolsters, parcel and tar them, put over the runner and tackle-pendants, then the foremost of the starboard-shrouds, then the larboard, and so on; then the stay and spring stay, seize in the dead eyes for the shrouds, and the harts for the stay, reeve the lanyards, set up the rigging, get the top over head, and bolt it, rattle down the shrouds, and seize on the cat-harpin-legs, hook the futtock shrouds and hitch them, seize down the ends, lash the hanging jeer blocks under the top, with the strops under the stays, lead up and lash to the mast-head, get the cap into the top for the head of the top-mast, and lash the blocks on for the main lifts.

Q. How do you get a top and cap over?

A. Make fast a girt-line block, on each side of the mast-head, reeve the girt-lines, and pass them under the top, and make them fast to the after-part of the top, stop them to the bolt holes in the middle and fore-part of the top, then sway away: when high enough, cut the upper stops, having a guy on the after part of the top-brim, and the top will fall over the mast-head, then lower away, and put it in its birth, haul upon the guy and bolt it, lay the cap steady over the trussel-trees for the top-mast head, to receive it; when the top-mast-head is through it, lash the cap to the top-mast till high enough, then place the cap on the mast-head, and drive it down.

Q. How do you rig a main-top-mast?

A. I will tar the mast-head, get the cross-trees over, fix the bolters and parcel them, put over burton-pendants, then the shrouds, and back-stays, proper and spring-stay, and cap, sway up the mast and fid it, seize in the dead eyes, stay the mast, set up the shrouds, rattle them down, lash the bullock-blocks to the mast-head.

Q. How do you rig a top-gallant-mast?

A. I will send down the top-rope, reeve it through the sheave-hole, and make it fast round the hounds of the mast, and standing part of the rope, leaving enough end to make fast to the cap for doubling, put on a seizing about half way up, which done, sway away; when the head is through the cap, make fast the spare end or standing part of the top-rope to the cap, cut the seizing, clap on the grummet, then the shrouds, back-stays and stay, sway up the mast, fid it, and set the rigging up.

Q. How do you rig a bowsprit?

A. I will lash the collar for forestay, the bob-stays and bowsprit shrouds, then the collar for the spring-stays, then the block for the top-mast stay, fix the man-rope, gammon the bowsprit, and set bob-stays

Q. How do you rig a jib-boom?

A. I will put over the traveller, horses, and guys, the top-gallant stay-block, and lash on the blocks for the top-gallant bowline and jib; down-haul block to the traveller.

Q. How do you rig a lower yard?

A. I will get the yard athwart the gunwale, lash the jeers, clue-garnets, bunt-lines, leach-lines, and slab-line blocks, then put over the yard-arms the horses brace, pendants, the yard tackle pendants, then the top-sail sheet and lift blocks, reeve the jeers, braces, lifts, and yard-tackle falls, truss parels, sway the yard up, haul all taut, and belay.

Q. How do you rig a fore-top-sail-yard?

A. I will reeve a hawser for a top-rope, through the bullock-block, and send it down, and having put over the horses, make the top rope fast to the middle of the yard, stopping it to the yard-arm, sway it above the top, put over the brace pendants and lift blocks, reeve the lifts and braces, cut the yard-arm seizing, and cross the yard, lash the tye, bunt-line, and clue-line block, reeve the tye and halyards, sway it up above the cap, and parel it, reeve the clue-lines, bunt-lines, and reef-tackles.

Q. How do you rig a top-gallant yard?

A. I will seize the clue-line-blocks on, put the horses over the yard-arms, sway it up on the cap, and rig the yard-arms, by putting on the brace-pendants and lifts, then cross the yard and parel it.

Q. You have lost your rudder at sea, what method will you take to steer the ship?

A. I will take a large spar, or part of a top-mast, and cut it flat in the form of a stern-post, bore holes at proper distances in that part which is to be the fore part of the preventer, or additional stern-post, then take the thickest plank I have on board, and make it as near as I can into the form of a rudder, bore holes at proper distances in the fore part of it, and in the after-part of the preventer stern-post to correspond with each other; and reeve rope grommets through those holes in the rudder and after-part of the stern-post, for the rudder to play upon.

Through the preventer stern-post reeve guys, and at the fore part of them fix tackles, and then put the machine over-board; when I get it in proper position, or in a line with the ship's stern-post, lash the upper part of the preventer-post to the upper part of the ship's stern-post, then hook tackles at or near the main chains, and bowse taut on the guys to confine it to the lower part of the stern-post;—having holes bored through the preventer and proper stern-post, I will run an iron bolt through both, taking care not to touch the rudder, which will prevent the false stern-post from rising up or falling down.

By the guys on the after-part of the rudder, and tackles fixed to them, I may steer the ship. I must take care to bowse taut the tackles on the preventer stern-post to keep it close to the proper stern-post.

Q. Your ship is leaky, you cannot keep her free by the pumps, what will you do?

A. I will take a spare top-sail, or some other sail, and spread it upon the deck, cover it all over with oakum, and bind it to the top-sail with a needle and twine in several places, to keep it fast to the sail, then take a hawser and cut it into proper lengths to go under the ship's bottom, and come in over the gunnel, put these hawsers about four feet distant under the sail, and make them fast with their middle to the middle of

the sails, and each leach, beginning at the head and leaving off at the clues:—Then put the sail over-board, keeping the oakum side to the ship's bottom, and haul up the ends of the hawsers on the other side by a hauling line which I have swept the ship with, numbering each end fore and aft; then ease away on the hawser's ends on that side I have put the sail over, and keep hauling at the same time on the hawser's ends on the opposite side. When the sail is properly down, which is known by marking the hawser; I will then clap on tackles and bowse all taut, keeping the sail close to the ship's bottom, the oakum will be drawn in, and stop the leak. The sail may be covered with dung, or any filth I have on board, which will be drawn in and stop the leak.

Q. Suppose the wind northerly, and you are in a ship's hawse in the Downs, what would you do?

A. I would wait until the ship tends to windward, and heave up my anchor as she is tending.

Q. How would you work a ship out of the Downs with the wind southerly?

A. I would stand to the Goodwins and in 10 or 11 fathoms, it being steep to; and to the shore in 8 fathoms water.

Q. Is there any danger in going out of the Downs?

A. Yes; between Deal and Walmer Castle there are shoals near the shore, not having more than 16 or 17 feet of water on them at spring tides; as I draw towards the Foreland, I would stand in shore, to 10 or 9 fathoms, and off to the South Sand-head, Upper Deal and Walmer Castles in one will lead me clear off; Deal Church being open with Walmer Castle about a ship's length, I must stand out till I bring the lights in one, then I am clear of the South Sand-head; and when Folkstone church is open with Hay Cliffs, it leads me clear. I must take care not to shut in the Hope land, and the South Sand-head will

Q. What is the course from the South Foreland to Dungeness, and what are the dangers?

A. From the South Foreland to Dungeness, the true course is S. W. by W. ½ W. distance 23 miles.

The Riprāps lie N. E. and S. W. about 5 leagues in length; the N. E. end bears from Dover Castle S. S. E. 4 leagues, from Folkstone S. E. by S. Calais steeple bears from it S. E. and Calais Cliffs S. S. E. 3 leagues, the S. W. end bears from Dungeness E. S. E. 4 leagues, on the N. E. part there are about 15 or 16 feet at low water, on the S. W. end 4 or 5 fathoms; it is steep to on both sides, having 20 and 22 fathoms close to it. To the westward of Folkstone, there is a ledge of rocks that runs a large mile off the shore. I would come no nearer in than 14 fathoms.

About 4 miles E. by N. from Dungeness, there is a shoal with not more than 12 feet on it, which I shall avoid by keeping in 10 fathoms.

Q. Where will you anchor, and in what depth of water, under Dungeness?

A. I would anchor with the NessPoint S. W. byW. the light-house W. S. W. athwart Romney Town, in 8, 9, or 10 fathom water.

There is a shoal about two miles to the westward of the Ness, with only 18 feet on it at low spring tides, the Ness light bears from it N. E. by E. 12 fathoms close to.

Q. What is the course from Dungeness to Beachy-head, and what are the dangers?

A. W. ½ S. distance about nine leagues.

Off the highland of Farleigh there is a shoal of rocky ground with 14 feet on it, and lies pretty close in. In the channel off Dungeness, there is 24 fathoms, and off Beachy-head from 26 to 30 fathoms; I will, in thick weather, keep in 15 or 20 fathoms, from the Ness to Beachy-head. When I deepen my water, haul to the northward, but if I shoal it, haul to the southward. In clear weather I may stand in shore until Beachy-head bears W. by N. and not have less than 10 fathoms of water, must then tack to avoid Pemsey Shoal, which lies about two miles off the shore, with Pemsey Church bearing N. and Beachy-head W. by S. 14 feet on it.

There is a shoal with 14 feet on it, and lies with Beachy-head W. ½ N. 12 miles; E. by S. 6 miles from Beachy-head is the Horse of Willington, a small shoal, having 16 feet on it at low water.

Q. Being off Beachy-head, at the close of a winter's evening, in a gale of wind at N. E. bound to Spithead, what is best to be done?

A. I would lie to with my ship's head to the N. N. W. till morning, then she will drive about a channel course at the rate of two knots an hour, allowing that what she would lose in the ebb, she would gain in the flood, and be in a fair way in the morning; I would come no nearer to the Owers than 18 or 20 fathoms.

Q. What is the course and dangers between Beachy-head and Dunnose?

A. The course is W. by N. ¾ N. distance about 20 leagues.

The dangers are, Owers; the mark to go clear off the east part of them, is the white way on Crow Hill in one with Chichester Church, a little to the eastward of Pegham Church, and the mark to clear the west end, is St. Rook's Hill in one with Chichester Church, they bear from Culver Cliff E. S. E. ½ S. about 4 leagues; *there is a floating light just to the Eastward of them;* in going down Channel, if I keep Dun-

nose W. N. W. Northerly, will carry me without them, I will come no nearer to them in thick weather than 18 or 20 fathoms.

Q. You are coming from the westward and off Dunnose, what would you do?

A. I would steer N. E. keeping Sandown Castle clear of Culver Cliff, bearing W. by N. then I may run in between Bembridge Ledge and the Princessa Shoal, but with a ship of a great draught of water, it is best to go without the Princessa Shoal, until I get the Kickergill on the S. W. part of Monkton Fort, and run into Spithead between the Buoy of the Dean and the Buoy of the Warner.

N. B. In going for Spithead from the eastward, there are 5 black buoys lying on the Dean and Horse, they must all be left on the starboard side: the outer one is called the East Buoy of Dean, it lies in 27 feet water, the marks for it are the flag-staff of Portsmouth platform, a little open to the westward of a round sentry-box of South Sea Castle, bearing N. by W. ¾ W. with Dunnose open off Culver Cliff.

From the outer buoy to the next is W. N. W. about one mile and a quarter, it lies in 6 fathoms; the third lies in 4 fathoms: the buoy of the Warner bears west southerly from this buoy about 1¾ mile; from the third to the fourth or Elbow buoy, is S. E. and N. W.; it lies in 3 fathoms.

The Buoy of the Horse bears from the third buoy N. N. W. about 1¾ mile, and lies in 3½ fathoms; from this last buoy to the first buoy of Sturbridge, the course is W. ¾ N. The Royal George lies in 13 fathoms, ¾ of a mile to the N. W. of the Edgar: the buoy of the Royal George, that of Noman's Land, and the Kickergill, lie in a line.

The two buoys of the Princessa Shoal lie N. E. by N. and S. W. by S. of each other, distance about a mile; they lie each in five fathoms with 4½ between them, the marks for the inner buoy, which is white, are Sandown Castle in one with Culver White Cliff, and Nettlestone Point on Bembridge Point, the buoy of Bembridge Ledge is black, and the Nob buoy is red, they lie E. N. E. and W. S. W. of each other, with Dunnose open of Culver Cliffs.

Q. Suppose you were to the northward of Bembridge Point, bound to Spithead, and the buoys were all gone, what would you do?

A. I would bring St. Helen's Church to bear W. and keep in twelve fathoms and steer N. by W. towards the Dean, keeping Ashdown-mark above the trees, will lead me into Spithead, abreast of Ride; if it is thick weather and the wind southerly, I will come no nearer to Bembridge Ledge than six fathoms, and steer N. W. by N. but if the wind is on the other side, I would come no nearer the Dean and Horse than 10 fathoms; observing the course and tides, I will anchor at Spithead with South Sea Castle N. E. by E. and the Kicker Point N. W. in 14 fathoms, East Indiamen and merchant ships generally anchor on the Mother Bank to the westward of the Sturbridge-buoy in 10 or 15 fathoms; if I am obliged to turn into Spithead, I may turn the Kickergill on each side of Fort Monkton, and come no nearer the Warner than 12 fathoms, nor to the Dean than 9 or 10 fathoms, nor to Noman's Land than 16 or 18 fathoms, being close to it.

Q. How do you come to anchor at St. Helen's?

A. I would keep Sandown Castle just open of Culver Cliffs, and bring St. Helen's Church a sail's breadth open of the Red Cliffs of Bembridge Point, and anchor in 8 or 9 fathoms.

Q. Suppose you were moored at Spithead with a cable and a half on the best bower, and one on the small bower, you have orders to

sail, at what time of the tide would you unmoor, and which anchor would you take up first?

A. I would begin to unmoor at the first of the flood, and take up my small bower first.

Q. In sailing within the Isle of Wight and through the Needles, what are your observations?

A. To keep clear of the West Middle, I would keep South Sea Castle a sail's breadth open of the Kicker Point until I shut in West Cowes Castle, then steer directly for East Cowes Point, giving it a birth, then steer for Hurst Castle, and when abreast of it, borrow pretty near it, then steer for the Needle's Point; the leading mark through the Needles is a House to the eastward of Lymington Creek, called Petwell Bath, in one with Hurst Castle, bearing N. E. by E. ¾ E. I must be careful to keep the vanes of the windmill which stands on the island in sight, to keep me clear of Warden Ledge; great regard must be had to the tides, for the flood sets on the Needles, and the ebb on the shingles, with great velocity. *N. B.* To the northward of the West Middle lies the Bramble; the Bramble and West Middle have each two buoys on them; if I sail to the northward of the West Middle, I must sail between it and the Bramble, leaving the Bramble on the starboard side; when I come to West Cowes Castle, I must give it a good birth, as there is a ledge of rocks that lie off it: Warden Rock lies on the island side with a buoy on it: when I come near the Needles, must give them a good birth to avoid the Chalk Rock *.

Q. What is your course from Dunnose to Portland?

A. W. by N. 18 leagues.

Q. If you are forced into Portland, what precautions are necessary?

A. I must take care of the shambles, they bear from Portland Lights, which lie north and south of each other, N. W. by W. 4 miles, with only 14 feet on them at low water; to sail into the road from the westward, I must keep close to the Bill, and keep my lead going; when I am round the East Point, haul up and anchor against the Pier, in 9 or 10 fathoms, with the Bill bearing S. S. E. Portland Castle S. S. W. and Weymouth Castle N. W. In sailing out of Portland Road, I must keep Week Church open of the Stone Pier, and that will carry me clear to the eastward of the Shambles.

The tide flows hard from the Road to the Bill E. S. E. 7 hours, and the flood sets right of the Bill 9 hours.

N. B. In case I should be embayed to the westward of Portland, and no possibility of getting out between Burton and Chiswell, where it ebbs 9 hours and flows only 3 hours, there is a steep beach of pebbles: I would there run my ship on shore with as much sail as I could carry, especially at the beginning of an ebb, and remain on board for three or four seas, when I may get on shore with safety.

Q. What is the course from Portland to Torbay, and how do you anchor there?

A. The course is W. N. W. and distance about 14 leagues; to anchor in the bay, I would bring the Berry Head to bear S. by E. or S. S. E. and Brixham Church on with the Pier; the best anchoring for small ships is 1½ from Brixham Pier Head, in 7 fathoms, or just to the Eastward of Torpier.

Q. What is your course from the Berry Head to the Start?

A. S. W. about 6 leagues.

* *For a more particular account, see the* DIRECTIONS *published by* JOHN HAMILTON MOORE. *Price 2s. 6d.*

Q. Is there any danger near the Start?

A. Yes, about two miles to the eastward of the Start, there is a shoal with not more than 9 feet on it: the Bolt Head being kept open of the Start Point, will carry me clear of it.

Q. What is your course from the Start to the Eddistone?

A. W. ¾ S. 7 leagues.

Q. What is your course from the Start to Ramhead?

A. W. N. W. 7 leagues.

Q. What is to be observed in sailing into Plymouth Sound?

A. If coming from the westward, and am got round the Ramhead, I must give Penlee Point a good birth, by reason of a ledge of rocks that lies off from it, then haul N. N. E. ¾ E. for anchoring; the leading mark in is Plymouth Church on with the middle Obelisk on the Hoa.

In going into the Sound I may anchor in Cawsand Bay, in 20 fathoms, with Penlee Point S. W. and the town of Cawsand W. N. W.

The leading-mark to carry me in between the Knap and Shovel, is Plymouth old church on with a white patch on the Hoa.

I may go into the Sound on the east side, between the Tinker and Shag-stone, by keeping Mount Batton a sail's breadth open of Staden Point, and keep in that direction until Maker's church bears N. W. and Withy Edge open, then haul over to the eastward and anchor.

Q. How do you sail into Hamoaze?

A. I would keep Kingsand open of Redding Point, until the large House at Stoke touches the East side of Mill Bay; steer in until the Obelisk comes on with Block House Point; keep in that direction, till the easternmost summer house on Mount Edgecomb Side comes open with the point within which it stands; then steer for it, until the east point of Mount Wise comes open with Block-house Point; then steer mid-channel for Stone-house Pool till Drake's Island is shut within Block-house Point: I must not open it till South Down comes open with the Obelisk, then steer up the harbour with the side of Drake's Island just touching Passage Point, which will lead me to the southward of the Harbour shoal, on the outer part of which there is a rock, with only sixteen feet on it, but on any other part there is a 3½ fathoms.

N. B. The marks to know the Sound when I am coming from sea in the day-time, are, Ram Church, which stands to the northward of the Ram-head, and a square tower standing on the highest part of the land.

Q. You are bound into Falmouth, how would you proceed?

A. In going to Falmouth, there is a rock, called the Block Rock, with a pole on it, and shows itself at half tide; it lies nearest to the west shore; I may sail in on either side of it, but the east side is the best. If I would sail into Carrick Road, I must keep in the fair way, and my lead going, as there is a narrow deep channel all the way, of 16 or 18 fathoms. I may borrow on St. Mawes side in 5 or 6 fathom. The best anchoring in Carrick Road, is St. Mawes Castle E. S. E. and lay my easternmost anchor in 16 or 18 fathoms, and my westernmost anchor in 4 or 5 fathoms. Just pass St. Mawes there is a sand that is steep to, called St. Mawes Sand, and lies almost half channel over.

N. B. Great ships anchor, with Manacle Point on with the point of Falmouth, or a great house, that is to the westward of Penryn, just open Trefusis Point, in 18 fathoms.—The Manacles lie from Falmouth about S. S.

Q. How do you know the Lizard when you first make it?

A. It is the southernmost land on the coast, and may be seen 7 or 8 leagues off, in 42 fathoms.

Q. How does the Land's End appear when you make it?

A. It appears in hummocks with a church on it, and may be seen 7 or 8 leagues off, in 54 fathoms.

Q. What are the dangers off the Land's End?

A. Many:—1st, The Runnel-stone lies about nine-tenths of a mile S. S. E. from Tol-peden-penwith.

2d, N. E. by N. from the Runnel-stone there is a rock, called the Leawmean, which appears at half ebb, with a passage between it and the main, seldom used by any but by coasters.

3d, The Wolf Rock; bears from Tol-peden-penwith W. S. W. distance 7½ miles; it is small and may be seen at half tide; the largest of the Bresam Rocks, kept open of the outermost of the Long Ships *(on which there is a light-house erected)*, will lead me clear to the westward of the Wolf.

4th, The Long Ships lie N. W. by N. about 3 miles from the S. W. point of the Land's End, and 1 mile W. N. W. from the westernmost point; they are high, and may be seen 4 or 5 leagues off.

5th, The Kettle-bottom, is a shoal with only 6 feet on it, and lies about half-way between the northernmost part of the Long Ships, and the west point of the Land's End.

6th, The Bresam rocks lie about 3 miles N. E. by N. ¾ E. from the Long Ships.

7th, The Seven Stones are a row of rocks that come not above water, but the sea always breaks over them; they lie from Cape Cornwall W. ½ S. dist. 5½ leagues; and from St. Martin's Head, Scilly, N. E. dist. 3 leagues.

Q. If you are forced into Mount's Bay, where would be the safest anchoring ground?

A. Mount's Bay lies between the Lizard and the Land's End; there is a high Island on the east side, and a Castle on the west side of it, called St. Michael's Mount; from the east side of it lies a ledge of rocks, near a league into the sea; the coast is full of rocks, and not safe to anchor in. To sail into the Bay I must bring St. Paul's steeple W. and keep over to the west shore, and make St. Clement's Island, which is before the town of Mousehole, having the castle on the starboard side; I shall then see a large sandy bay, and, when within the island, there is a good anchoring in 7 or 8 fathoms.

Q. If you are bound or forced to go into Scilly, what would you do?

A. I would steer for St. Mary's Sound, and run in for the southernmost Point of St. Mary's Island, called Penninis Point, minding to keep the lead going, and approach no nearer than 5 fathoms water; about N. W. of Penninis Point, a little more than half a mile, is the Woolpack, the shoal lies near to the shore; I must continue to run in 5 or 6 fathoms, keeping pretty close to St. Mary's Island, to avoid the Spanish Ledge, which lies about half a mile W. by S. from Penninis Point; some part of this shoal may be seen at low water, and part of the Woolpack shows itself before low water; when I have got abreast of the Woolpack, to which I must give a good birth, about a cable's length, and steer for the Stevel Rock which is bold to; when I am abreast of the Stevel, must then steer N. W. by W. until Little Crow Island comes on with Bantscarren Point; then steer N. N. E. until Crow Island comes open a ship's length of Bantscarren Point, or bring the castle, which is on St. Mary's Island, to bear S. S. E. and anchor in 6 or 5 *fathoms water.*

THE METHOD OF EXERCISING MERCHANT SHIPS' COMPANIES FOR WAR.

It is not presumed, in the following pages, to offer any hints to the officers in the Royal Navy, who may be said to be trained up in the school of war: we only attempt the humbler task of suggesting a few observations to the commanders of merchant ships, who, occupied in commercial pursuits in time of peace, are sometimes deficient in the method of defending themselves when attacked in time of war. We would first recommend to station their crews according to their rank and capacities, by forming a quarter bill, and to exercise them in their respective stations. As merchant ships are so variously fitted out with guns and men, it is impossible to form a quarter bill to suit all. We have, however, given two quarter bills, one for a trading ship of fourteen six-pounders, and fifty men, and the other for a privateer of twenty nine-pounders, and 160 men, which may be varied as circumstances and the difference of guns, carriages, and men, may require.

A Quarter Bill for a Trading Ship of Fourteen Six-pounders and Fifty Men.

The captain to command in chief, on the quarter-deck, if it be fortified to afford common shelter from small arms	1
The chief mate to command the six foremost guns, and work the ship forward	1
The second mate to command the eight aftermost guns	1
The boatswain to pass the word, and get the captain's orders executed fore and aft, as occasion may require	1
The carpenter to attend the pumps, shot-plugs, &c.	1
The gunner to deliver the powder to the boys, as carriers	1
The doctor in the lowest, safest, and most convenient place, the ship affords	1
A good man at the helm	1
Four men to each gun and its opposite, and a boy to fetch powder	35
Seven men at small arms and occasional duty	7
	50

A Quarter Bill for a Privateer of Twenty Guns, Nine-pounders, and Four Three-pounders on the Quarter-Deck and Forecastle.

The captain to command the whole	1
The master to assist and work the ship according to orders	1
A midshipman to pass the word of command fore and aft	1

A quarter-master at the cun, and another at the helm	2
The first marine officer with 24 musketeers	25
Three men for the two three-pounders, and a boy to fetch powder	4

On the Main Deck.

The first lieutenant to command the ten foremost guns	1
The second lieutenant to command the ten aftermost guns	1
The gunner to assist and attend all the great guns fore and aft	1
The two master's mates to attend the fore-topsail braces, and work the ship forward according to orders	2
The boatswain's mate, with two seamen, to assist in working the ship, and to repair the main rigging	3
The carpenter and his crew to attend the pump, and the wings about the water's edge, fore and aft, with shot-plugs, &c.	4
Six men to each of the ten guns on a side, and its opposite, and a boy to fetch powder	70

On the Forecastle.

The boatswain to command, with two seamen to work the ship and repair the fore rigging	3
Three men, and a boy, to fetch powder, for the two three-pounders	4
The second marine officer, with nine musketeers	10
In the barge upon the booms, the third marine officer with eight musketeers	9
In the main top, five men with a midshipman at small arms, and to observe the conduct and condition of the enemy	6
In the fore top, five men at small arms and to repair the rigging	5
In the mizen top, three men at small arms and to repair the rigging	3
In the powder-room, the gunner's mate with an assistant to fill and hand powder to the boys, carriers	2
In the cock-pit, the doctor and his mate	2
	160

Here it may not be amiss to remark, that the people should be quartered to fight nearest to where they are stationed to work the ship; that is, the after guard on the quarter deck, the waisters in the waist, forecastle men that are necessary in the forecastle, &c. The quarter bill and discipline of the crew should be kept from disorder as long as possible; and when occasional duty requires the people to be let go from their quarters, it should not be done at random, but with judgement, such as will suit the occasion, from the musketeers, or a man from each great gun, &c. where they can be best spared.

On Preparing for Exercise or Action.

When all hands are called to quarters, every man should bring his

hammock well lashed up, and stow it to the greatest advantage to give shelter from small arms nearest to his own quarters, or give it to some of his messmates where they are most wanted, that they may know readily where to find them when exercise or action is over.

When the hammocks are properly stowed, the officers, according to their stations and duties, are to see the ship effectually cleared of all incumbrances, and every thing prepared, so that nothing may be wanting that is necessary for exercise or action.

The lieutenants or mates, with the gunner on the gun deck, are to get all the hatches laid, except that where the powder is to be handed up; a match tub half filled with water, and four matches in the notches, placed as near midship as possible to serve two guns and their opposites; also swabs to wet the decks, to prevent the fatal consequences that may attend the scattered and blown powder from the priming of the guns making a train fore and aft, which has, in many instances, taken fire from the firing of the guns, and done great damage. It is further the duty of the lieutenants to see that the captain of each gun has his men, powder-horn, rope-spunge, rammer, crows, handspikes, and train tackles, all ready in their proper places.

The boatswain must get the yards slung, the topsail sheets stoppered, and marlinespikes ready to repair the standing or running rigging that may be damaged.

The carpenters are to get the pumps rigged, and shot plugs, with all that is necessary, ready in their proper places, to stop leaks and repair damages.

The gunner, when preparing for action, is to see that the charges in the guns are dry, and that there is a sufficient quantity of wads, and shot of all sorts, and cartridges ready filled.

The marine officers are to see all the musketeers at their quarters, with their arms and ammunition in good order for exercise or action.

Exercise of the Great Guns.

1 Silence	8 Fire
2 Cast loose your guns	9 Spunge your guns
3 Level your guns	10 Load with cartridge
4 Take out your tompions	11 Shot your guns
5 Run out your guns	12 Put in your tompions
6 Prime	13 House your guns
7 Point your guns	14 Secure your guns.

1. Silence.

At this word every one is to observe a silent attention to the officers.

2. Cast loose your Guns.

The muzzle lashing is to be taken off from the guns, and, being coiled up in a small compass, is to be made fast to the eye-bolt above the port, the lashing-tackles at the same time to be cast loose, and the middle of the breeching seized to the thimble of the pomillion. The spunge to be taken down, and with the crow, handspike, &c. laid upon the deck by the gun.

N. B. When prepared for engaging an enemy, the seizing within

the clinch of the breeching is to be cut, that the gun may come sufficiently within board for loading, and that the force of the recoil may be more spent before it acts upon the breeching.

3. Level your Guns.

The breech of your metal is to be raised, so as to admit the foot of the beds being placed upon the axle-tree of the carriage, with the quoin upon the bed, both their ends being even one with the other.

N. B. When levelled for firing, the bed is to be lashed to the bolt which supports the inner end of it, that it may not be thrown out of its place by the violence of the gun's motion, when hot with frequent discharges.

4. Take out your Tompions.

The tompion is to be taken out of the gun's mouth, and left hanging by its laniard.

5. Run out your Guns.

With the tackles hooked to the upper bolts of the carriage, the gun is to be bowsed out as close as possible, without the assistance of crows or handspikes; taking care at the same time to keep the breeching clear of the trucks, by hauling it through the rings; it is then to be bent so as to run clear when the gun is fired. When the gun is out, the tackle-falls are laid along-side the carriages in neat fakes, that when the gun, by recoiling, overhauls them, they may not be subject to get foul, as they would if in a common coil.

6. Prime.

Take off the apron and unstop the touch-hole, that the cartridge may be pierced with the priming-wire, and the touch-hole filled with powder, the pan also is to be filled; and the flat space, having a score through it at the end of the pan, is to be covered, and this part of the priming is to be bruised with the round part of the horn. The apron is to be laid over, and the horn put up out of danger from the flash of the priming.

7. Point the Guns.

At this command the gun is, in the first place, to be elevated to the height of the object, by means of the side sights; and then the person pointing is to direct his fire by the upper sight, having a crow on one side, and a handspike on the other, to heave the gun by his direction till he catches the object.

N. B. The men who heave the gun for pointing are to stand between the ship's side and their crows or handspikes, to escape the injury they might otherwise receive from their being struck against them or splintered by a shot; and the man who attends the captain with a

o bring it at the word, "Point your guns;" and kneeling knee opposite the train truck of the carriage, and at such a to be able to touch the priming, is to turn his head from the keep blowing gently upon the lighted match to keep it clear . And as the missing of an enemy in action, by neglect or olness, is most inexcusable, it is particularly recommended e people thoroughly instructed in pointing well, and taught ne inconveniences of not taking proper means to hit their erefore they should be made to elevate their guns to the ut- y, and then to point with the same exactness, having caught through the upper sight. At the word,

8. Fire,

tch is instantly to be put to the bruised part of the priming; the gun is discharged, the touch-hole is to be stopped, in nother any spark of fire that may remain in the chamber of and the man who spunges is immediately to place himself by e of the gun in readiness, when at the next word,

9. Spunge your Guns,

nge is to be rammed down to the bottom of the chamber, wisted round, to extinguish effectually any remains of fire; drawn out to be struck against the outside of the muzzle, to ny sparks or scraps of the cartridge that may have come out d next its end is to be shifted ready for loading; and while ng, the man appointed to provide a cartridge, is to go to the

12. Put in your Tompions.

The tompions to be put into the muzzle of the cannon.

13. House your Guns.

The seizing is to be put on again upon the clinched end of the breeching, leaving it no slacker than to admit of the gun's being housed with ease. The quoin is to be taken from under the breech of the gun, and the bed, still resting upon the bolt, within the carriage, thrust under, till the foot of it falls off the axletree, leaving it to rest upon the end which projects out from the foot. The metal is to be let down upon this. The gun is to be placed exactly square, and the muzzle is to be close to the wood, in its proper place for passing the muzzle-lashings.

14. Secure your Guns.

The muzzle-lashings must be first made secure, and then with one tackle (having all its parts equally taut with the breeching) the gun is to be lashed. The other tackle is to be bowsed taut, and by itself made fast, that it may be ready to cast off for lashing a second breeching.

N. B. Care must be taken to hook the first tackle to the upper bolt of the carriage, that it may not otherwise obstruct the reeving of the second breeching, and to give the greater length to the end part of the fall. No pains must be spared in bowsing the lashing very taut, that the guns may have the least play that is possible, as their being loose may be productive of very dangerous consequences. The quoin, crow, and handspike, are to be put under the gun, the powder-horn hung up in its place, &c.

Being engaged at any time when there is a large swell, a rough sea, in squally weather, &c. as the ship may be liable to be suddenly much heeled, the port tackle-fall is to be kept clear, and (whenever the working of the gun will admit of it) the man charged with that office is to keep it in his hand; at the same time the muzzle lashing is to be kept fast to the ring of the port, and being hauled taut, is to be fastened to the eye-bolt, over the port-hole, so as to be out of the gun's way in firing, in order to haul it in any time of danger.

This precaution is not to be omitted, when engaging to windward, any more than when to leeward, those situations being very subject to alter at too short a warning.

A train tackle is always to be made use of with lee-guns, and the men stationed to attend it are to be very careful in preventing the gun's running out at an improper time.

THE METHOD OF ATTACKING OR DEFENDING A SHIP.

As soon as the ship has got to sea, I would recommend to take the first favourable opportunity to have all hands called to quarters, the officers in their stations to have every thing made properly ready and

fit for action; to have a general exercise not only of the great guns and small arms, but the method of working and managing the ship, to take advantage of the openings which often occur in attacking or being attacked by another single ship, which should be studied by every commander, and the designed manœuvres should be taught the people in their general exercise, that they may know how to act and move regularly from one place and side to the other as occasion may require, without confusion, which is always the case when the intended manœuvres are not made known to the people.

For these reasons, as soon as possible, it should be made known to them, that if a ship of nearly equal force should bring to with a design to fight, it was intended not to run directly alongside, and lie to like a log, and depend upon mere battering with one side only, or upon the stern chase-guns. Begin the attack upon the weather quarter, shooting the ship up in the wind, with the helm a-lee, till the after lee gun, with which you should begin, can be brought to bear upon the enemy's stern, then fire the lee broadside. Immediately boxhaul the ship round on her heel, so as to bring the wind so far aft, that the ship may be steered close under the enemy's stern, giving particular orders to begin with the foremost gun to rake them right fore and aft, as they pass in that line of direction, all aiming and firing to break the neck and cheeks of the rudder's head, the tiller ropes, blocks, &c. so as if possible to destroy the steering tackle, which design, if it proves successful, takes the management of their ship from them, so that she must lie helpless for a time in spite of their endeavours.

When the aftermost gun is fired, put the helm hard a-weather to bring the ship to the wind on the other tack, to keep clear of their lee broadside, and act according to their motions, and the experience of the effect your attack has had upon them. If they continue to lie to, either renew the attack again in the same manner as soon as the ship will fetch the weather quarter again, or make sail off to escape, if it is found that the great inequality of their superior force admits of no possible chance of conquering them. And although this manœuvre may not have given this advantage (which in my opinion ought always to be attempted, and not to submit tamely although a ship is doubly the force) yet the power of their broadsides may be chiefly avoided by it.

But when the inequality of force is not so great but there is a possibility of conquering, and if the success of the first attack is perceived to oblige the enemy to continue lying to in order to repair the damage done their rudder or tiller, &c. then the blow should be followed, by renewing the attack again with all possible expedition, in the same manner, which gives the opening not only to fire the whole round of great guns to advantage, but also to the marines and topmen to fire their small arms at the same time to great advantage, so as to do the most execution possible, by firing and raking them fore and aft through their most open and tender part, the stern, with the least risk possible from the enemy's guns, and therefore gives the greatest possible chance to make an easy conquest, especially if so lucky as to destroy and prevent the recovery of their steering. A ship of much superior force may be brought to such a distressed condition, as to be obliged to make a submission for want of the helm to command her, therefore when an opportunity offers in fighting this should be always aimed at.

But suppose the enemy laid to as above mentioned, find themselves

not much hurt by this manœuvre, and that you have not succeeded in destroying their steering, and therefore you may expect that they will immediately tack or wear ship, and stand after you, depending upon their superior sailing and force, shall run up along your lee side, expecting, by making a general discharge of their small arms and great guns on your deck, which lies open to them by the ship's heeling, to destroy your people, and to make you submit: when this is likely to be their design, orders should be given to your people, to keep themselves as close under shelter as possible from their small shot until their general discharge is over; then if the ship is found not so disabled, but that the topsails can be thrown aback, make a general discharge from the lee side of the great guns, loaded with round shot only, pointed to the weather side of the enemy's bottom amidships, to one point at the water edge, and boxhaul the ship to run close under their stern, aiming at raking and destroying their steering with the other broadside; then stand off on the other tack, and act according to circumstances and the condition you find yourself in compared with the appearance of the enemy and their motions, who may be obliged to continue on the other tack to repair damages.

But when the enemy's ship of force makes only a running fight, and you have the advantage of sailing faster, the most sure and likely method to make an easy conquest, is to run close up, and shoot or sheer your ship across their stern each way, making a general discharge of all your force, aiming with the great guns at the rudder-head and steering tackling; and you will have this advantage, that if the shot miss the rudder-head, by raking the ship fore and aft through the stern, they may do the greatest execution possible to distress the enemy, so as to make a submission. On this occasion, when it blows fresh, and you are obliged to carry a pressing sail large or before the wind, to make the great guns as ready as possible, and prevent their being fired too low, all their breeches should be laid quite down in the carriage, and if your ship is crank the yards should be braced so as to shiver the sails at the time each broadside is fired. In all these manœuvres, where the whole round of great guns are designed to be fired, two or more men ought always to be left to load each gun again when fired on one side, whilst the others move over again to fire the opposite, that neither side may be left unguarded.

These or any other manœuvres may be taught the people, by heaving a tight empty beef-cask over-board, and making it the object of attack. Nor would I advise to spare a little powder on these occasions, as a little expended in exercise may save a great deal fired to no purpose in action. Two ships sailing in company afford an excellent opportunity of exercising manœuvres.

Note. At the end of this work are given two tables; one showing the proportion of powder for sea guns, the other the number of shot contained in different-sized grapes.

ON SHIPS IN DISTRESS.

SUDDEN distress of ships has often struck their crews with such panics, as to occasion them, in many instances, to take the worst instead of the best means *or methods* for their safety or relief. It will not, there-

st, be unacceptable to endeavour to point out every thing that service on these melancholy occasions, as far as circumstances ons can be conceived to happen.

ship proves weak and works the oakum out, so as to make leaks between wind and water, it has been frequently prac- il sheet-lead upon the seams, which is subject to break by the king. Leather or canvass nailed on slack, with oakum under, r the purpose much better. In cases where ships have worked es loose, it has been frequently practised with success, to take ns of a hawser or cable round them, and to heave these turns o prevent foundering.

dangerous leak suddenly break out, as soon as the pumps l and set to work, the utmost endeavours should be imme- d, and all possible means tried, to find out and stop the leak, people become exhausted by continual pumping; when dis- would recommend fothering; for a description of which, see f this work.

and get a Ship upright from being overset or laid on her Side at Sea.

ertainly a task that deserves the utmost attention. If ground ached by any means, the lee anchor or anchors should be y let go, in order to bring the wind upon that bow that is that the wind may act upon the masts and sails, which may s to bring the ship upright again. But in deep water, where n be of no service, it is recommended, if a tow-line, hawser, d, can be readily come at, and if the driver boom, hen-coops,

coming into shoal water, and a boom rigged out on each side, close aft athwart the stern, with a block on each at equal distances, as far as they can be supported from the stern, and a block on the rail or gunnel exactly opposite the middle of the wheel barrel, where the steering rope, marked with a rope yarn in the middle, is to be taken with three or five turns round the wheel, when the midship spoke and the mark on the rope are right up; then the two ends to be passed across from the under part of the wheel, and reeved through the blocks on each side, and made fast to the hawser or cable that is towed astern exactly amidships, and as tight as it can well be to go clear of the stern; and then veer and heave freely from side to side, as the steering of the ship, with the trimming of the sails on this occasion, may require.

[See the Plate and Description of Captain Peckenham's Makeshift Rudder, published in the 7th volume of the Transactions of the Society of Arts, Manufactures, and Commerce, which is earnestly recommended to the attention of all Commanders.]

On preserving Boats from foundering when ships founder.

Sling any mast, yard, or spar, the longer the better, by each end, the bight of the span to be twice the length of the boom; bend the boat rope exactly in the middle of the bight of the span, which need not be above 10 fathom long: let your boat drive end on under the lee of this boom, which will break off the violence of the sea from her.

On a ship being near a dangerous Lee-shore.

To keep a ship off a dangerous lee-shore, every effort of mind and body should be exerted, as being the only chance to save the lives of the crew and property on board. Carrying such sail as will give her good way through the water upon a wind, as long as she will carry it, is certainly the best method to effect this purpose; it is also advisable to reduce all tophamper that holds wind as much as possible; for if the shore proves so deep, or the bottom so rocky, as not to afford safe anchorage, their safety may depend entirely on carrying sail.

Suppose in this situation it is found that the ship will not clear the shore on either tack, and after the utmost endeavours she is perceived to lose ground; but as there is no anchorage, there is no other means but to continue turning to the last, as the wind may abate, or may vary or change in your favour, even when you think it is the last tack you can possibly make before you must inevitably go on shore.

But when it happens that there is clear anchoring ground at a good distance from the shore, and sailing proves ineffectual to keep clear of it, then the chief dependence must be upon the ground tackle applied to the best advantage.

Suppose then the ship to be properly prepared, and to have let go a kedge anchor and tow-line bent like a buoy-rope to the crown of the stream anchor, and the inner end of the stream-cable bent to the crown of the best bower or sheet-anchor, with a long scope of cable to make the ship ride safe and easy; where it is known, or found by sounding with the lead armed with tallow, that the ground is foul, then no more cable should be veered out than necessity requires to bring the ship up, to ride with as short a scope as possible, because the cable is liable *to be cut or chafed*; if that happens there is then the more room

astern, and a better chance for a second or third anchor, trying to the last moment all possible means to keep the ship from the shore.

Where the water is so deep that the anchoring ground lies but a little more than a cable's length from the shore, then all the anchors should be let go to the best advantage. To put this difficult performance in practice, I would recommend to get the square sails handed with all possible dispatch, but to keep the fore topmast, main, and mizen stay-sails set, the yards braced full, and the helm put hard a-weather to keep headway upon the ship, shooting her along the shore as much as possible till all the anchors are let go, beginning with the weathermost anchor, or that which has the cable in the weathermost hawse hole, and so on with the next weathermost anchor, paying out the cable as fast as possible, that the ship may keep shooting ahead till all the anchors are let go. And when the necessity of the situation requires it, no hesitation should be made, immediately to cut away all the masts, except the foremast and the bowsprit (the fore topmast stay-sail being made to hoist to the foremast-head); which will not only make the ship ride with less strain upon the anchors and cables, but if they give way she will be the better prepared, when necessity requires it to be done, as the last refuge, to run and lay the ship on shore to the best advantage, in order to save all the lives and property that is possible to be saved, rather than let the ship founder, or strike the ground at an anchor by the tide falling, &c., which affords no chance of saving either lives or property.

On Ships being forced on a dangerous Lee Shore.

Situations, circumstances, times, and places, are so different and various, that to give advice on this dreadful occasion is difficult. The best management on a gradual rising shore, in a tidesway, is to use all possible means to keep the ship from going on shore till after high water, and the main and mizen-mast being first cut away, then to run right before the wind and waves with all the canvass that possibly can be set, end on upon the shore, to make the ship free herself the more, and to run the higher and faster upon the ground, so that by the advantage of the tide falling, she may soon be set so fast as to be out of the power of the waves to hurt her much. By this management, in my opinion, not only all the lives, but the ship and cargo may be often saved, which would be all lost by letting her go at random with a flowing tide. For it must be considered, that a ship going on shore in a tidesway upon a flood will continue beating as long as the tide flows and until it falls; and if she lies broadside to the waves, they will have about three times more power on her than when they laid end on to them; and a ship will bear but little beating on her broadside, in proportion to what she will bear upon her bottom.

Notwithstanding a ship may be thus successfully run and set fast upon a shore with little damage to her hull, and no danger to be apprehended till towards high water next tide, if the storm continue so long, yet people too often let their fears overcome their reason, and, being in too great hurry to quit the ship, and attempting to get on shore through the waves, may often lose their lives; when if they wait till low water they might get on shore with little or no risk; and where the rise and fall of the tide is great the ship may come quite dry at low water: therefore, the people should be restrained from going on shore with the boats till towards low water; and when got safe on shore,

it may be absolutely necessary, in order to preserve the boats, to haul them above high-water mark, where they may be turned bottom up, and made a place of shelter when there is no other to be had, and be still ready to go to the ship, if the weather permits and occasion requires.

Different shores require different management on this dreadful occasion. And where the shore is nothing but hard rocks steep to, and under water, and high cliffs above water, which are impossible to be climbed up, in this situation no sail can be of any service, therefore all the masts should be cut away, and safety then depends entirely on the ground tackle being used to the best advantage; and if the ship drives till she comes near the high cliffs, it is well known they make both the wind and waves rebound from them to some distance, where if the ground tackle happen to hold, it may give the ship a chance to ride.

On saving Lives from a Ship lost on a Lee Shore.

TO aid and assist in saving the lives of people from ships that are forced on a dangerous lee-shore, must be allowed to be one of the greatest acts of humanity. Time, circumstances, and situations, are so various, that it is very difficult to write what may be to the purpose on this melancholy occasion. Success in many situations may depend greatly on assistance from people on shore; but as that is uncertain and cannot be expected in the night, or in desert places, or where a current or tide runs so strong between the tide and the shore as to prevent booms, masts, yards, &c. with ropes made fast to them, from being veered on shore, in this case the utmost endeavours should be used on board, and every method tried to convey the people on shore. Let the experiment of a *Flying Storm Kite* be made, that may by the force of the wind carry an iron creeper or grappling made fast to the end of a rope from the wreck to the shore, by which access may be got to the shore when prevented by the tide, current, or returning waves. I would propose these kites to be such as may be easily and readily made on board any wrecked vessel, and to consist only of two slips of thin deal board, about three inches broad, the long piece to be 7, 8, or 9 feet long, according to the weight of the creeper, grappling, or boat's anchor, and the rope designed to be sent on shore and the cross piece about half the length of the long piece, to be nailed about a third from the top that forms the kite, to be spanned with log or lead line from the four ends of the boards, and covered with a piece of light sail, and slung from the four ends of the boards, and strengthened with a span in the middle to the lower part of the cross board, where the kite-rope is to be seized, and at the lower end of the kite a rope 2, 3, or 4 fathoms long is to be bent to the grappling, creeper, or boat's anchor, to answer the purpose of the kite's tail. Then it may be asked, how the kite may be made to fall so low that the anchor, &c. may take hold of the ground, if necessity requires this immediately to be done? Let the kite-rope run loose for a time, and the weight of the anchor, rope, &c. will immediately make it fall upon the ground; and to the kite-line a larger rope may be hauled on shore by the inhabitants, and fixed so that not only lives but property may be saved by it.

But in order to get a grappling on shore another experiment might be made, viz. to shoot it with a rope bent to it lashed along the outer end of a handspike, made round just to fit the bore of a great gun, and long

enough to reach from the ring of the grappling to the wad next the powder; the gun elevated to its highest range.

Let it now be supposed that a rope is got from the wreck to the shore, and secured as well as possible, till somebody can be got on shore by it to secure it better. Make a bowling knot in the tail of the strap of a single block; then reeve the shore rope through the block, and to that part of the wreck where it may lead and be hauled taut to the greatest advantage to support the block, travelling upon it from the wreck to the shore in the surest and best manner possible; and if the wreck have any lower masts standing, the shore rope leading over the main-mast head would most likely answer the purpose best, and the top afford a convenient place to get fixed in, and go from, in the machine to the shore.

But the facility or difficulty attending the execution of these means, are in proportion to the height and distance of the shore from the wreck; if the shore be low and near the wreck, the shore rope may be made to lead the machine upon it, with an easy ascent from the wreck to the shore, with a man or two in it, without much strain either to the rope, or grappling on shore; when this is likely to be the case, a line should be made fast to the machine to haul it to the wreck again; by which means it may happen that a shipwrecked crew may soon get on shore with ease and safety.

But when the shore happens to be at a great distance and higher than any part of the wreck, this experiment will of course be attended with more difficulty. In order, therefore, to ease the strain on the shore rope and grappling, fix a small sail to the machine, such as a hammock or two, &c. this, set as a sail upon the machine that is to run right before the wind in a storm, will certainly help greatly to lift and lessen the strain of the machine on the shore rope, and force it forward with great power towards the shore. A man or two got on shore by these means may greatly contribute, by making things secure on shore, to the saving the whole crew, before the ship goes to pieces.

But supposing the ship to be wrecked where there is neither tide nor current to prevent any thing that will float being drove on shore by the waves; in this case a towline, or any suitable rope with a hauling line, may be made fast about the middle of a spar, and veered away on shore as far as it will go; and if it happens to be an uneven rocky shore, it may chance to fix itself fast amongst the rocks. But if it be a sandy or gravelly shore, then no such chance can be expected; it will then require some people on shore to haul it up, and put it under the sand or gravel, with its broadside to the wreck, to make it bear the strain that is necessary for the rope to be tight enough for the machine to travel upon from the wreck to the shore.

Before concluding this article we shall give a description of the MARINE SPENCER, presented to the Royal Humane Society of London by Mr. KNIGHT SPENCER, and communicated to me, together with the Resuscitative Process, by Dr. Hawes, Treasurer to the above Society, conceiving they may be of infinite use in many instances.

The Marine Spencer is a girdle of diameter to fit the body, six inches broad, composed of about 800 old tavern corks strung upon a strong twine, well lashed together, covered with canvass and painted in oil, so as to make it water-proof. Two tapes or cords, about two feet long, must be fastened to the back of the girdle, with loops at the ends.

Another tape or cord, about three feet long, in the middle of which a few corks are strung covered with canvass, and painted as above, must also be fastened to the back of the girdle. Two pins of hard wood, three inches long and half an inch diameter, must be fastened to the front of the girdle, one to the upper, the other to the lower part. When the Marine Spencer is to be used, slide it from the feet close up under the arms; bring the two tapes or cords one over each shoulder, and fasten them by the loops to the pin on the upper part of the front of the girdle; bring the other tape or cord between the legs, and fasten it to the other pin.

A person thus equipped, though unacquainted with swimming, may safely trust himself to the waves; for he will float head and shoulders above the water in any storm, and by paddling with his hands may easily gain the shore.

A Marine Spencer constructed as above, and covered with strong canvass unpainted, will have nearly the same buoyancy, though more liable to damage from the effects of sea water*.

We further add the Resuscitative Process, wishing to contribute all in our power to the benefit of our seafaring brethren.

* There is now in vogue a Leather Girdle, which, when filled with air, they have given the name of Life Preserver.

Directions for the Restoration of the Drowned, those suspended by the Cord, intense Cold, or tremendous Lightning.

1. CONVEY carefully the body, with the head raised, and send to the nearest medical assistant.

2. Strip, dry the body, clean the mouth and nostrils.

3. Young children to be put between two persons in a warm bed.

4. An adult—Lay the unfortunate person on a bed, and in cold weather near the fire. In summer expose the body to the rays of the sun, and air should be freely admitted.

5. The body to be gently rubbed with flannel sprinkled with spirits, flour of mustard, &c. salt never to be employed; also a *heated warming pan*, properly covered, may be lightly moved over the back and spine.

6. *To restore Breathing.*—Introduce the pipe of a bellows (when no apparatus is at hand) into *one* nostril; *the other* and the mouth being closed, *inflate the lungs*, till the breast be a little raised; the mouth and nostrils must then be let free. This process to be repeated till the return of life.

7. The breast to be fomented with hot spirits; warm bricks or tiles covered, &c. to be applied to the soles of the feet and palms of the hands.

8. Tobacco-smoke is to be thrown gently into the fundament with a proper instrument, or the bowl of a pipe covered, so as to defend the mouth of the assistant.

9. Electricity to be early employed, either by the medical assistants, or other judicious practitioners.

It is much to be lamented that the most approved methods of assisting ships in distress are not recommended or described in prints, for the

being distributed amongst our ships, and amongst the inha-
g our sea coast; and rewards should be held out to the poor
g shore for every human life saved by them from vessels in
hich rewards might also be the means of saving their own
he just laws of their country, by preventing them from plun-
might encourage them to join heartily in whatever method
ve people on board the wreck take to preserve themselves,
them in it, by securing the shore rope, or using the hauling
the machine on shore, if it is high above the wreck, &c.
ty we now meet with in manning both ships of war and
ips, should teach us to use every possible method to preserve
our brave seamen, those supporters of our glory, power,
consequence, as a nation. How pleasing must the reflec-
ll who contribute to help them!

calculated to assist Commanders when coming into the British Channel.

ers know that their reckonings are always uncertain, in
to the length of their several passages from the times
departure, it is natural to suppose that they must, when
g to any difficult and dangerous navigation, experience great
mind for the issue. As the British Channel has proved fatal
may be fairly ranked among those places which are deemed
o ships, in their approach after long passages; and, there-
ose who are intrusted with the conducting of ships through
acquire such knowledge as may enable them to perform the

of green; and in proceeding 16 or 17 leagues further to the eastward in this latitude, you will have 72, 75, 77, and 80 fathoms. The soundings will be, for the most part, fine sand, but different in colour; some of them will be white sand, mixed with yellow specks; and others fine green sand, with some mud. In the latitude of 48° 23′ North, and 61 leagues to the westward of Ushant, lies the Nymph Bank. It stretches about S. S. E. and N. N. W. 12 leagues in length and four in breadth; and has 64 fathoms on it, fine grey sand.

The following are the Soundings in the Parallels of 48° 20′, and 48° 30′, with their several depths of Water and Distances from the Island of USHANT.

Dist. from Ushant.	QUALITY OF THE SOUNDINGS.	Depth in Fathoms.	
Leagues.		Fren. Fm.	Eng. Fm.
52 —	Fine grey sand, mixed with black	— 98	83
49 —	Fine grey sand, mixed with small shells and broken bits . . .	— 106	96
46 —	Grey sand, mixed with bits of brown shells	— 110	99
43 —	Grey sand, mixed with bits of shells and brown sand . . .	— 108	97
40 —	Grey sand, mixed with bits of shells and gravel	— 117	106
37 —	Grey sand, mixed with shells and gravel	— 104	94
35 —	Grey sand, mixed with small cornet shells	— 110	99
32 —	Sand mixed with gravel, shells, and small cornets	— 108	97
29 —	Whitish grey sand and flat stones . .	— 108	97
24 —	Light grey sand, with bits of shells . . .	— 100	90
21 —	Coarse sand, with bits of cockle shells . .	— 98	88
18 —	Light grey sand, with bits of brown and yellow shells, and small stones .	— 90	81
15 —	Light grey sand, mixed with barley-beards	— 84	76
14 —	Whitish grey sand, bits of shells and fine cornets	— 80	72
11 —	Light grey sand, mixed with barley-beards and small shells . . .	— 79	71
9 —	Fine grey sand, with bits of shells . .	— 75	68
8 —	Grey sand, spotted with red, and mixed with bits of shells . . .	— 75	68
6 —	Whitish coarse shining sand, with fine shells	— 70	63
4 —	Whitish coarse shining sand, mixed with barley-beards and coral . . .	— 65	59
2 —	Whitish coarse sand	— 64	58

When running for the Channel in latitude 49° 25′, which is the best latitude, and you have run so far to the eastward as to shoalen your water to 65 or 67 fathoms, and the soundings are shells and small yellow stones or red sand, you may thence conclude that you are abreast of Scilly; or if you have 68 fathoms, white sand with grey specks, and sometimes shells and stones, Scilly will then bear about N.E. from you, distance 10 leagues. Your soundings will always inform you whether you are to the northward or southward of Scilly. In the latitude of Scilly you will have oazy ground, in 60, 65, 75, or 80 fathoms. W. N. W. 10 leagues from Scilly,

lies Jones's Bank, on which you will have but 30, 35, and 40 fathoms; and, a little to the southward of it, you will have 72 and 75 fathoms. In running for the Channel, in the latitude of 49° 30′, you will have the following depths of water and soundings, when you are abreast Scilly; namely, 60 fathoms, oaze and broken shells; 64 fathoms, white sand with grey specks; 65 fathoms, shells and stones; and 55 fathoms, fine grey sand. The soundings near Scilly are very different from all others in this latitude: pieces of rotten rock, as broad as a small bean, and of a stone colour, will come up with the lead, which will not be the case any where else in the same parallel. More to the southward you will have deeper water, with fine sand, interspersed with black specks like ground pepper. In the night, or in foggy weather, you should come no nearer to Scilly than 60 fathoms; for, in that depth, you will not be more than six or seven leagues from it. Abreast of Scilly, in the latitude of 49° 20′, you will have 70 fathoms, branny, or yellow and white sand; and, to the eastward of Scilly, in the latitude of 49° 8′, you will have 56 or 58 fathoms, coarse sand. You should then steer more to the northward, and endeavour to make the land about the Lizard; you may safely make it in the night, as well as in the day, if the weather be clear; for the light-houses stand so high, and the coast is so clear, that you may, without danger, come within half a mile of the point. If the weather prove so thick that you cannot safely make the land, come no nearer to the Lizard than 45 fathoms; for, in that depth, you will not be more than three leagues off the point: your soundings there will be pebble stones and scallop shells.

Ships, when coming into the Channel, ought always, if possible to make the land about the Lizard; and should they afterwards meet with thick weather, they will not only know how to steer but also how they advance up the Channel, which will become more and more necessary in proportion to the contraction of its boundaries. Some have, contrary to their expectations, got on the south side of the Channel. This error is greatly owing to the strong indraught between the islands of Guernsey and Jersey, and the coast of Britany, which ought always to be guarded against, especially in thick weather. It frequently happens that ships, coming into the Channel, have not had an observation for some days back, which, together with the operation of scant and contrary winds, and the setting of the tides, tend to perplex and bewilder the most experienced mariner, when thick weather prevents him from getting a sight of the land. The variation of the compass in the entrance of the Channel, is nearly 27° W.; but as the variation is continually increasing at the rate of about a degree in every five years and a half, it will be necessary to add eleven minutes for every year, subsequent to the year 1810, which will give you the true variation at any time pretty exact.

EXPLANATION AND USE

OF

THE TABLES.

TABLE I.

Difference of Latitude and Departure for Points and Quarters.

The points and quarters under four points are found on the top of the table, and those above are found at bottom, to the distance of 300.

TABLE II.

Difference of Latitude to every Degree of the Quadrant.

The explanation and use of Tables I and II. have examples in every Question in Plane, Middle Latitude, and Mercator Sailing, &c.

TABLE III.

Logarithmic Sines, Tangents, and Secants, to every Point and Quarter of the Compass.

The points and quarters are contained in the first and last columns, and the log. sines, tangents, and secants, in the intermediate columns.

TABLE IV.

Logarithms,

Contains the logarithms of natural numbers from 1 to 10,000, and to 5 decimal places of figures: the index is always one less than the number of integral figures in the natural number. See page 19.

TABLE V.

Log. Sines, Tangents, and Secants.

This table contains the log. sine, tangent, and secant, to every minute of the quadrant. See page the 26.

TABLE VI.

Meridional Parts.

The meridional parts are to be taken out with the degrees of latitude at the top or bottom, and for the miles or minutes on either side.

TABLE VII.

Mean Refraction

Is always to be added to the zenith distance, or subtracted from the observed altitude.

TABLE VIII.

Dip of the Horizon.

The number opposite the height of the eye above the surface of the sea, is to be subtracted from the observed altitude.

TABLE IX.

Sun's Parallax in Altitude.

ber of minutes opposite the observed altitude is to be added ved altitude.

TABLE X.

Moon's Augmentation.

ber answering to the moon's altitude is to be added to the zontal semidiameter.

TABLE XI.

Dip at different Distances from the Observer.

ber opposite the distance, and under the height of the eye, racted from the observed altitude.

TABLE XII.

Sun's Declination.

e year and month, and opposite to the day of the month, s in the left-hand column, stands the declination for that at Greenwich, which you are to observe whether it is north

TABLE XIII.

the Sun's Declination. For reducing the Sun's Declination ny Meridian, and to any Time under that Meridian.

To be added or subtracted according as the declination is either increasing or decreasing; but if the time is before noon or east longitude, the application of the sum is reverse to the former.

TABLE XIV.

Sun's Right Ascension.

This table is sufficiently exact for finding when any star comes to the meridian, in order to obtain a latitude; but for all cases and calculations for determining apparent time, the sun's right ascension must be taken out of the Nautical Almanack for the given year.

TABLE XV.

The Right Ascension and Declination of the principal fixed Stars.

Beneath the table is a note, showing how to correct the stars to any time before or after the year 1808.

TABLE XVI.

For turning Degrees and Minutes into Time, and the contrary.

The manner of using this table, is plain from the following examples.

Ex. 1. Reduce 78° 35′ 15″ to time.

		H.	M.	S.
Opposite to 78° in 3d column	-	5	12	0
to 35′ in 1st do.	-		2	20
to 15″ in 1st do.	-			1
78 35 15		5	14	21

Ex. 2. Convert 6 h. 50′ 36″

Opposite to 6 h. 48′ 0 in column 4th is	102° 0′
to 2′ 36″ in do. 2d is	39′
6 50′ 36″	102° 39′

TABLE XVII.

To reduce the Time of the Moon's Passage over the Meridian of Greenwich, to the Time of its Passage over any other Meridian.

This table is to be entered with the daily variation at the top (which is found page 6, in the Naut. Alm.) and the longitude of the place on the left-hand side column, the minutes corresponding, are to be added to the time of the moon's passage over the meridian of Greenwich, if the longitude be west, or subtracted, if east.

Ex. At what time will the moon pass the meridian of Cape Horn, in longitude 68° 13′ W. on the 5th of December 1810?

Moon's passage over the meridian of Greenwich, Dec. 5, by N. A. - - - - - - - - - - -	8 h	0′
Correction corresponding to daily var. 48 m. and long. 68° 13′ W. + - - - - - - - - - -	0	9
Time of the moon's passing the mer. of Cape Horn, Dec. 5.	8	9

TABLE XVIII.

Decimals to every Minute in Twelve Hours.

The use of the table is at the bottom of table XVII.

TABLE XIX.

Of Amplitudes.

e is used in finding the variation of the compass. See page

TABLE XX.

Time of the Sun's Rising, Setting, and the Length of the Day and Night.

nd the sun's declination at the top of the table (marked with of declination), and the latitudes in the right or left-hand arked lat.), and in the common angle of meeting is the time ng, if the sun has north declination, but the time of sun-e sun has south declination.

et it be required to find the time of the sun's rising and set-the length of the day and night, in latitude 51° north, the y, 1810.

ek the sun's declination for the given day, and find it 20° which I here call 21°, then under the declination 21, and latitude 51, stands 7 h. 53 m. the time the sun sets on the in lat. 51 north, which being doubled, gives 15 h. 46 m. the he day; and if 7 h. 53 m. the time of the sun's setting, be from 12 h. the remainder 4 h. 7 m. gives the time of the , which being doubled, gives 8 h. 14 m. length of the night.

To find the Rising and Setting of the Stars.

By this table the rising and setting of any star may be found, whose declination does not exceed 23° 28′ north or south, in the following manner:

If you are in north latitude and the star has north declination, look for the declination at the top, and the latitude in the right or left-hand columns, in the angle of meeting, is half the time of the star's continuance above the horizon in that latitude, or the time it takes in ascending from the eastern side of the horizon to the meridian, and descending from the meridian to the western part of the horizon.

Therefore, if these hours and minutes be subtracted from the time of the star's coming to the meridian, the remainder will be the time of the star's rising, and if added, the sum will be the time of the star's setting.

For finding when the star comes on the meridian, see page 213.

Ex. 1. Required when the star Arcturus rises and sets, December 1, 1810, in latitude 51 degrees North.

The time of the star's coming to the meridian, or southing in the morning, page 213	0 59
Then under star's declination 20° 11′, or 20° N. and against latitude 51 stands	7 47
Time of star's rising in the morning	1 52
Added, gives the time of the star's setting	17 26
	12
Star sets 22 minutes after 5 in the evening	5 26

When the latitude is north, and the star has south declination, or the latitude south, and the star has north declination, find the latitude in the side columns as before, against which, and under the degrees of declination, stands half the time the star is under the horizon, which being subtracted from 12, the remainder will be half the time the star will be above the horizon in that latitude.

Example. What time will the star Virgin's spike, rise and set at London, June 7, 1810.	12 0
Under the declination 10° 10′ S. and against latitude 51° 32′ or 52° stands	6 52
Half the time the star is above the horizon	5 8
The star comes to the meridian in the evening, at	3 13
Which subtracted, shows that the star rises 5 [illegible] minutes after 3 in the evening	[illegible] 5
Added, shows the time the star sets in the morning	[illegible] 21

In like manner may the rising and setting of the planets be found when their declination does not exceed 23° ½, and the time of their passage over the meridian is known, which is found in page 4th of the Nautical Almanack.

Suppose it were required to find the moon's rising and setting, Aug. 26, 1811, in latitude 52° north.

In the Nautical Almanack (page 6th), I find that the moon passes the

Greenwich at 7 h. 21 m. in the evening, and her declination s 18° 5′ south.

e tables, under the declination 18° S. and against the latids 7 h. 38 m. Half the time she is under the horizon h. 16 m. the length of the lunar night, which subtracted aves 8 h. 44 m. the lunar day. To the moon's southing er the meridian, 7 h. 2 m. add half the lunar day, 4 h. 1 h. 24 m. her setting in the afternoon, and from 7 h. 2 m. he remainder 2 h. 40 m. is the time of her rising in the

anner may be found the rising and setting of the other observing that the noon of the common day, and end of s the beginning of the day in the Nautical Almanack. calculations here are made for the meridian of Greenwich, taken to reduce the time of their passages over the meriwich to the meridian of the place of observation, by allowfor every 15° of west longitude, and 1 h. sooner for every ongitude.

TABLE XXI.

finding the distance of Terrestrial Objects at Sea.

, third, fifth, and seventh column, from the left, are the of the object; in the next column, is the distance in miles parts of a mile.

TABLE XXV.

Proportional Logarithms.

These logarithms are adapted for finding the apparent time at Greenwich, by comparing the observed distance of the moon and sun, or of the moon and a fixed star, when reduced to the true, with the same distances set down in the Nautical Almanack, for every three hours of Greenwich time. These logarithms are very useful where sexagesimals are a part of the calculation.

TABLE XXVI.

For computing the Effects of Parallax on the Moon's Distance from the Sun or a Star.

Look for the corrected distance in the top column, and the correction of the moon's altitude, in the left-hand side column, take out the number of seconds that is found under the former, and opposite the latter.

Look again, in the same distance column, and the principal effects of the moon's parallax in the left-hand side column, and take out the number of seconds that stand under the former and opposite the latter, the difference of these two numbers must be added to the corrected distance if less than 90°, but substract from it if more than 90°.

In working by the method shown in page 238, should the distance of the objects be above 90 degrees, you must look in table 26 with the apparent distance at the top, and the moon's correction in the left-hand side column, the number found subtracted from 20, leaves the third correction. In the same column, and corresponding to the difference of corrections, is another number, which, when subtracted from 20, leaves the fourth correction.

N. B. The different numbers found under 95°, 100°, 105°, 110°, 115°, 120°, &c. subtracted from 20, will leave the numbers as are in the table at the end of table 26.

TABLE XXVII.

For reducing Minutes into Seconds, and the contrary.

The use is so plain, that it requires no explanation.

TABLE XXVIII.

Latitudes and Longitudes.

This table contains the latitudes and longitudes (from the meridian of Greenwich) of the principal capes, headlands, points, ports, harbours, rocks, shoals, &c., in the world.

TABLE XXIX.

A General Tide Table.

This table, ranged alphabetically, shows the times of high-water at the several places at the full and change of the moon; and the vertical

ater in feet and inches at the highest spring-tide, which in
are the third high-water after the full and change; at other
her places, it is on the third day that the highest tide is.
ave great power over the tides, causing them to vary very
as to time and to the vertical rise of the tide.

of the Log-book, as now used on board His Majesty's Navy.

F.	Courses.			Winds.		Lee-way.	Remarks on Board, &c.		
							A. M. or before Noon.		
/	Dist.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.		Diff. of Long.	Long. in.	Bearings and Dist. at Noon.

TABLE I. Difference of Latitude and Departure for ¼ Point.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.0	61	60.9	03.0	121	120.9	05.9	181	180.8	08.9	241	240.7	11.8
2	02.0	00.1	62	61.9	03.0	22	121.9	06.0	82	181.8	08.9	42	241.7	11.9
3	03.0	00.1	63	62.9	03.1	23	122.9	06.0	83	182.8	09.0	43	242.7	11.9
4	04.0	00.2	64	63.9	03.1	24	123.9	06.1	84	183.8	09.0	44	243.7	12.0
5	05.0	00.2	65	64.9	03.2	25	124.8	06.1	85	184.8	09.1	45	244.7	12.0
6	06.0	00.3	66	65.9	03.2	26	125.8	06.2	86	185.8	09.1	46	245.7	12.1
7	07.0	00.3	67	66.9	03.3	27	126.8	06.2	87	186.8	09.2	47	246.7	12.1
8	08.0	00.4	68	67.9	03.3	28	127.8	06.3	88	187.8	09.2	48	247.7	12.2
9	09.0	00.4	69	68.9	03.4	29	128.8	06.3	89	188.8	09.3	49	248.7	12.2
10	10.0	00.5	70	69.9	03.4	30	129.8	06.4	90	189.8	09.3	50	249.7	12.3
11	11.0	00.5	71	70.9	03.5	131	130.8	06.4	191	190.8	09.4	251	250.7	12.3
12	12.0	00.6	72	71.9	03.5	32	131.8	06.5	92	191.8	09.4	52	251.7	12.4
13	13.0	00.6	73	72.9	03.6	33	132.8	06.5	93	192.8	09.5	53	252.7	12.4
14	14.0	00.7	74	73.9	03.6	34	133.8	06.6	94	193.8	09.5	54	253.7	12.5
15	15.0	00.7	75	74.9	03.7	35	134.8	06.6	95	194.8	09.6	55	254.7	12.5
16	16.0	00.8	76	75.9	03.7	36	135.8	06.7	96	195.8	09.6	56	255.7	12.6
17	17.0	00.8	77	76.9	03.8	37	136.8	06.7	97	196.8	09.7	57	256.7	12.6
18	18.0	00.9	78	77.9	03.8	38	137.8	06.8	98	197.8	09.7	58	257.7	12.7
19	19.0	00.9	79	78.9	03.9	39	138.8	06.8	99	198.8	09.8	59	258.7	12.7
20	20.0	01.0	80	79.9	03.9	40	139.8	06.9	200	199.8	09.8	60	259.7	12.8
21	21.0	01.0	81	80.9	04.0	141	140.8	06.9	201	200.8	09.9	261	260.7	12.8
22	22.0	01.1	82	81.9	04.0	42	141.8	07.0	02	201.8	09.9	62	261.7	12.9
23	23.0	01.1	83	82.9	04.1	43	142.8	07.0	03	202.8	10.0	63	262.7	12.9
24	24.0	01.2	84	83.9	04.1	44	143.8	07.1	04	203.8	10.0	64	263.7	13.0
25	25.0	01.2	85	84.9	04.2	45	144.8	07.1	05	204.8	10.1	65	264.7	13.0
26	26.0	01.3	86	85.9	04.2	46	145.8	07.2	06	205.8	10.1	66	265.7	13.1
27	27.0	01.3	87	86.9	04.3	47	146.8	07.2	07	206.8	10.2	67	266.7	13.1
28	28.0	01.4	88	87.9	04.3	48	147.8	07.3	08	207.7	10.2	68	267.7	13.2
29	29.0	01.4	89	88.9	04.4	49	148.8	07.3	09	208.7	10.3	69	268.7	13.2
30	30.0	01.5	90	89.9	04.4	50	149.8	07.4	10	209.7	10.3	70	269.7	13.2
31	31.0	01.5	91	90.9	04.5	151	150.8	07.4	211	210.7	10.4	271	270.7	13.3
32	32.0	01.6	92	91.9	04.5	52	151.8	07.5	12	211.7	10.4	72	271.7	13.3
33	33.0	01.6	93	92.9	04.6	53	152.8	07.5	13	212.7	10.5	73	272.7	13.4
34	34.0	01.7	94	93.9	04.6	54	153.8	07.6	14	213.7	10.5	74	273.7	13.4
35	35.0	01.7	95	94.9	04.7	55	154.8	07.6	15	214.7	10.5	75	274.7	13.5
36	36.0	01.8	96	95.9	04.7	56	155.8	07.7	16	215.7	10.6	76	275.7	13.5
37	37.0	01.8	97	96.9	04.8	57	156.8	07.7	17	216.7	10.6	77	276.7	13.6
38	38.0	01.9	98	97.9	04.8	58	157.8	07.8	18	217.7	10.7	78	277.7	13.6
39	39.0	01.9	99	98.9	04.9	59	158.8	07.8	19	218.7	10.7	79	278.7	13.7
40	40.0	02.0	100	99.9	04.9	60	159.8	07.9	20	219.7	10.8	80	279.7	13.7
41	41.0	02.0	101	100.9	05.0	161	160.8	07.9	221	220.7	10.8	281	280.7	13.8
42	41.9	02.1	02	101.9	05.0	62	161.8	08.0	22	221.7	10.9	82	281.7	13.8
43	42.9	02.1	03	102.9	05.1	63	162.8	08.0	23	222.7	10.9	83	282.7	13.9
44	43.9	02.2	04	103.9	05.1	64	163.8	08.1	24	223.7	11.0	84	283.7	13.9
45	44.9	02.2	05	104.9	05.2	65	164.8	08.1	25	224.7	11.0	85	284.7	14.0
46	45.9	02.3	06	105.9	05.2	66	165.8	08.1	26	225.7	11.1	86	285.7	14.0
47	46.9	02.3	07	106.9	05.3	67	166.8	08.2	27	226.7	11.1	87	286.7	14.1
48	47.9	02.4	08	107.9	05.3	68	167.8	08.2	28	227.7	11.2	88	287.7	14.1
49	48.9	02.4	09	108.9	05.4	69	168.8	08.3	29	228.7	11.2	89	288.7	14.2
50	49.9	02.5	10	109.9	05.4	70	169.8	08.3	30	229.7	11.3	90	289.7	14.2
51	50.9	02.5	111	110.9	05.4	171	170.8	08.4	231	230.7	11.3	291	290.7	14.3
52	51.9	02.6	12	111.9	05.5	72	171.8	08.4	32	231.7	11.4	92	291.6	14.3
53	52.9	02.6	13	112.9	05.5	73	172.8	08.5	33	232.7	11.4	93	292.6	14.4
54	53.9	02.7	14	113.9	05.6	74	173.8	08.5	34	233.7	11.5	94	293.6	14.4
55	54.9	02.7	15	114.9	05.6	75	174.8	08.6	35	234.7	11.5	95	294.6	14.5
56	55.9	02.7	16	115.9	05.7	76	175.8	08.6	36	235.7	11.6	96	295.6	14.5
57	56.9	02.8	17	116.9	05.7	77	176.8	08.7	37	236.7	11.6	97	296.6	14.6
58	57.9	02.8	18	117.9	05.8	78	177.8	08.7	38	237.7	11.7	98	297.6	14.6
59	58.9	02.9	19	118.9	05.8	79	178.8	08.8	39	238.7	11.7	99	298.6	14.7
60	59.9	02.9	20	119.9	05.9	80	179.8	08.8	40	239.7	11.8	300	299.6	14.7
Dist.	Dep	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 7 ¾ Points.

TABLE I. Difference of Latitude and Departure for ½ Point.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.1	61	60.7	06.0	121	120.4	11.9	181	180.1	17.7	241	239.8	23.6
2	02.0	00.2	62	61.7	06.1	22	121.4	12.0	82	181.1	17.8	42	240.8	23.7
3	03.0	00.3	63	62.7	06.2	23	122.4	12.1	83	182.1	17.9	43	241.8	23.8
4	04.0	00.4	64	63.7	06.3	24	123.4	12.2	84	183.1	18.0	44	242.8	23.9
5	05.0	00.5	65	64.7	06.4	25	124.4	12.3	85	184.1	18.1	45	243.8	24.0
6	06.0	00.6	66	65.7	06.5	26	125.4	12.3	86	185.1	18.2	46	244.8	24.1
7	07.0	00.7	67	66.7	06.6	27	126.4	12.4	87	186.1	18.3	47	245.8	24.2
8	08.0	00.8	68	67.7	06.7	28	127.4	12.5	88	187.1	18.4	42	246.8	24.3
9	09.0	00.9	69	68.7	06.8	29	128.4	12.6	89	188.1	18.5	49	247.8	24.4
10	10.0	01.0	70	69.7	06.9	30	129.4	12.7	90	189.1	18.6	50	248.8	24.5
11	10.9	01.1	71	70.7	07.0	131	130.4	12.8	191	190.1	18.7	251	249.8	24.6
12	11.9	01.2	72	71.7	07.1	32	131.4	12.9	92	191.1	18.8	52	250.8	24.7
13	12.9	01.3	73	72.6	07.2	33	132.4	13.0	93	192.1	18.9	53	251.8	24.8
14	13.9	01.4	74	73.6	07.3	34	133.4	13.1	94	193.1	19.0	54	252.8	24.9
15	14.9	01.5	75	74.6	07.4	35	134.4	13.2	95	194.1	19.1	55	253.8	25.0
16	15.9	01.6	76	75.6	07.4	36	135.3	13.3	96	195.1	19.2	56	254.8	25.1
17	16.9	01.7	77	76.6	07.5	37	136.3	13.4	97	196.1	19.3	57	255.8	25.2
18	17.9	01.8	78	77.6	07.6	38	137.3	13.5	98	197.0	19.4	58	256.8	25.3
19	18.9	01.9	79	78.6	07.7	39	138.3	13.6	99	198.0	19.5	59	257.8	25.4
20	19.9	02.0	80	79.6	07.8	40	139.3	13.7	200	199.0	19.6	60	258.7	25.5
21	20.9	02.1	81	80.6	07.9	141	140.3	13.8	201	200.0	19.7	261	259.7	25.6
22	21.9	02.2	82	81.6	08.0	42	141.3	13.9	02	201.0	19.8	62	260.7	25.7
23	22.9	02.3	83	82.6	08.1	43	142.3	14.0	03	202.0	19.9	63	261.7	25.8
24	23.9	02.4	84	83.6	08.2	44	143.3	14.1	04	203.0	20.0	64	262.7	25.9
25	24.9	02.5	85	84.6	08.3	45	144.3	14.2	05	204.0	20.1	65	263.7	26.0
26	25.9	02.5	86	85.6	08.4	46	145.3	14.3	06	205.0	20.2	66	264.7	26.1
27	26.9	02.6	87	86.6	08.5	47	146.3	14.4	07	206.0	20.3	67	265.7	26.2
28	27.9	02.7	88	87.6	08.6	48	147.3	14.5	08	207.0	20.4	68	266.7	26.3
29	28.9	02.8	89	88.6	08.7	49	148.3	14.6	09	208.0	20.5	69	267.7	26.4
30	29.9	02.9	90	89.6	08.8	50	149.3	14.7	10	209.0	20.6	70	268.7	26.5
31	30.9	03.0	91	90.6	08.9	151	150.3	14.8	211	210.0	20.7	271	269.7	26.6
32	31.8	03.1	92	91.6	09.0	52	151.3	14.9	12	211.0	20.8	72	270.7	26.7
33	32.8	03.2	93	92.6	09.1	53	152.3	15.0	13	212.0	20.9	73	271.7	26.8
34	33.8	03.3	94	93.5	09.2	54	153.3	15.1	14	213.0	21.0	74	272.7	26.9
35	34.8	03.4	95	94.5	09.3	55	154.3	15.2	15	214.0	21.1	75	273.7	27.0
36	35.8	03.5	96	95.5	09.4	56	155.3	15.3	16	215.0	21.2	76	274.7	27.1
37	36.8	03.6	97	96.5	09.5	57	156.2	15.4	17	216.0	21.3	77	275.7	27.2
38	37.8	03.7	98	97.5	09.6	58	157.2	15.5	18	217.0	21.4	78	276.7	27.2
39	38.8	03.8	99	98.5	09.7	59	158.2	15.6	19	217.9	21.5	79	277.7	27.3
40	39.8	03.9	100	99.5	09.8	60	159.2	15.7	20	218.9	21.6	80	278.7	27.4
41	40.8	04.0	101	100.5	09.9	161	160.2	15.8	221	219.9	21.7	281	279.6	27.5
42	41.8	04.1	02	101.5	10.0	62	161.2	15.9	22	220.9	21.8	82	280.6	27.6
43	42.8	04.2	03	102.5	10.1	63	162.2	16.0	23	221.9	21.9	83	281.6	27.7
44	43.8	04.3	04	103.5	10.2	64	163.2	16.1	24	222.9	22.0	84	282.6	27.8
45	44.8	04.4	05	104.5	10.3	65	164.2	16.2	25	223.9	22.1	85	283.6	27.9
46	45.8	04.5	06	105.5	10.4	66	165.2	16.3	26	224.9	22.2	86	284.6	28.0
47	46.8	04.6	07	106.5	10.5	67	166.2	16.4	27	225.9	22.3	87	285.6	28.1
48	47.8	04.7	08	107.5	10.6	68	167.2	16.5	28	226.9	22.3	88	286.6	28.2
49	48.8	04.8	09	108.5	10.7	69	168.2	16.6	29	227.9	22.4	89	287.6	28.3
50	49.8	04.9	10	109.5	10.8	70	169.2	16.7	30	228.9	22.5	90	288.6	28.4
51	50.8	05.0	111	110.5	10.9	171	170.2	16.8	231	229.9	22.6	291	289.6	28.5
52	51.7	05.1	12	111.5	11.0	72	171.2	16.9	32	230.9	22.7	92	290.6	28.6
53	52.7	05.2	13	112.5	11.1	73	172.2	17.0	33	231.9	22.8	93	291.6	28.7
54	53.7	05.3	14	113.5	11.2	74	173.2	17.1	34	232.9	22.9	94	292.6	28.8
55	54.7	05.4	15	114.4	11.3	75	174.2	17.2	35	233.9	23.0	95	293.6	28.9
56	55.7	05.5	16	115.4	11.4	76	175.2	17.3	36	234.9	23.1	96	294.6	29.0
57	56.7	05.6	17	116.4	11.5	77	176.1	17.3	37	235.9	23.2	97	295.6	29.1
58	57.7	05.7	18	117.4	11.6	78	177.1	17.4	38	236.9	23.3	98	296.6	29.2
59	58.7	05.8	19	118.4	11.7	79	178.1	17.5	39	237.9	23.4	99	297.6	29.3
60	59.7	05.9	20	119.4	11.8	80	179.1	17.6	40	238.8	23.5	300	298.6	29.4
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 7 ½ Points.

TABLE I. Difference of Latitude and Departure for ¾ Point.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.1	61	60.3	09.0	121	119.7	17.8	181	179.0	26.5	241	238.4	35.4
2	02.0	00.3	62	61.3	09.1	22	120.7	17.8	82	180.0	26.7	42	239.4	35.5
3	03.0	00.4	63	62.3	09.2	23	121.7	18.0	83	181.0	26.8	43	240.4	35.7
4	04.0	00.6	64	63.3	09.4	24	122.7	18.2	84	182.0	27.0	44	241.3	35.8
5	04.9	00.7	65	64.3	09.5	25	123.6	18.3	85	183.0	27.1	45	242.3	35.9
6	05.9	00.9	66	65.3	09.7	26	124.6	18.5	86	184.0	27.3	46	243.3	35.1
7	06.9	01.0	67	66.3	09.8	27	125.6	18.6	87	185.0	27.4	47	244.3	36.2
8	07.9	01.2	68	67.3	10.0	28	126.6	18.8	88	186.0	27.6	48	245.3	36.4
9	08.9	01.3	69	68.3	10.1	29	127.6	18.9	89	187.0	27.7	49	246.3	36.5
10	09.9	01.5	70	69.2	10.3	30	128.6	19.1	90	187.9	27.9	50	247.3	36.7
11	10.9	01.6	71	70.2	10.4	131	129.6	19.2	191	188.9	28.0	251	248.3	36.8
12	11.9	01.8	72	71.2	10.6	32	130.6	19.4	92	189.9	28.2	52	249.3	37.0
13	12.9	01.9	73	72.2	10.7	33	131.6	19.5	93	190.9	28.3	53	250.3	37.1
14	13.8	02.1	74	73.2	10.9	34	132.5	19.7	94	191.9	28.5	54	251.3	37.3
15	14.8	02.2	75	74.2	11.0	35	133.5	19.8	95	192.9	28.6	55	252.2	37.4
16	15.8	02.3	76	75.2	11.2	36	134.5	20.0	96	193.9	28.7	56	253.2	37.6
17	16.8	02.5	77	76.2	11.3	37	135.5	20.1	97	194.9	28.9	57	254.2	37.7
18	17.8	02.6	78	77.2	11.4	38	136.5	20.2	98	195.9	29.0	58	255.2	37.9
19	18.8	02.8	79	78.1	11.6	39	137.5	20.4	99	196.8	29.2	59	256.2	38.0
20	19.8	02.9	80	79.1	11.7	40	138.5	20.5	200	197.8	29.3	60	257.2	38.1
21	20.8	03.1	81	80.1	11.9	141	139.5	20.7	201	198.8	29.5	261	258.2	38.3
22	21.8	03.2	82	81.1	12.0	42	140.5	20.8	02	199.8	29.6	62	259.2	38.4
23	22.8	03.4	83	82.1	12.2	43	141.5	21.0	03	200.8	29.8	63	260.2	38.6
24	23.7	03.5	84	83.1	12.3	44	142.4	21.1	04	201.8	29.9	64	261.1	38.7
25	24.7	03.7	85	84.1	12.5	45	143.4	21.3	05	202.8	30.1	65	262.1	38.9
26	25.7	03.8	86	85.1	12.6	46	144.4	21.4	06	203.8	30.2	66	263.1	39.0
27	26.7	04.0	87	86.1	12.8	47	145.4	21.6	07	204.8	30.4	67	264.1	39.2
28	27.7	04.1	88	87.0	12.9	48	146.4	21.7	08	205.7	30.5	68	265.1	39.3
29	28.7	04.3	89	88.0	13.0	49	147.4	21.9	09	206.7	30.7	69	266.1	39.5
30	29.7	04.4	90	89.0	13.2	50	148.4	22.0	10	207.7	30.8	70	267.1	39.6
31	30.7	04.5	91	90.0	13.4	151	149.4	22.2	211	208.7	31.0	271	268.1	39.8
32	31.7	04.7	92	91.0	13.5	52	150.4	22.3	12	209.7	31.1	72	269.1	39.9
33	32.6	04.8	93	92.0	13.6	53	151.3	22.4	13	210.7	31.2	73	270.0	40.1
34	33.6	05.0	94	93.0	13.8	54	152.3	22.6	14	211.7	31.4	74	271.0	40.2
35	34.6	05.1	95	94.0	13.9	55	153.3	22.7	15	212.7	31.5	75	272.0	40.4
36	35.6	05.3	96	95.0	14.1	56	154.3	22.9	16	213.7	31.7	76	273.0	40.5
37	36.6	05.4	97	95.9	14.2	57	155.3	23.0	17	214.7	31.8	77	274.0	40.6
38	37.6	05.6	98	96.9	14.4	58	156.3	23.2	18	215.6	32.0	78	275.0	40.8
39	38.6	05.7	99	97.9	14.5	59	157.3	23.3	19	216.6	32.1	79	276.0	40.9
40	39.6	05.9	100	98.9	14.7	60	158.3	23.5	20	217.6	32.3	80	277.0	41.1
41	40.6	06.0	101	99.9	14.8	161	159.3	23.6	221	218.6	32.4	281	278.0	41.2
42	41.5	06.2	02	100.9	15.0	62	160.2	23.8	22	219.6	32.6	82	278.9	41.4
43	42.5	06.3	03	101.9	15.1	63	161.2	23.9	23	220.6	32.7	83	279.9	41.6
44	43.5	06.5	04	102.9	15.3	64	162.2	24.1	24	221.6	32.9	84	280.9	41.7
45	44.5	06.6	05	103.9	15.4	65	163.2	24.2	25	222.6	33.0	85	281.9	41.8
46	45.5	06.7	06	104.9	15.6	66	164.2	24.4	26	223.6	33.2	86	282.9	42.0
47	46.5	06.9	07	105.8	15.7	67	165.2	24.5	27	224.5	33.3	87	283.9	42.1
48	47.5	07.0	08	106.8	15.8	68	166.2	24.7	28	225.5	33.5	88	284.9	42.3
49	48.5	07.2	09	107.8	16.0	69	167.2	24.8	29	226.5	33.6	89	285.9	42.4
50	49.5	07.3	10	108.8	16.1	70	168.2	24.9	30	227.5	33.7	90	286.9	42.6
51	50.4	07.5	111	109.8	16.3	171	169.1	25.1	231	228.5	33.9	291	287.9	42.7
52	51.4	07.6	12	110.8	16.4	72	170.1	25.2	32	229.5	34.0	92	288.8	42.8
53	52.4	07.8	13	111.8	16.6	73	171.1	25.4	33	230.5	34.2	93	289.8	43.0
54	53.4	07.9	14	112.8	16.7	74	172.1	25.5	34	231.5	34.3	94	290.8	43.1
55	54.4	08.1	15	113.8	16.9	75	173.1	25.7	35	232.5	34.5	95	291.8	43.3
56	55.4	08.2	16	114.7	17.0	76	174.1	25.8	36	233.4	34.6	96	292.8	43.4
57	56.4	08.4	17	115.7	17.2	77	175.1	26.0	37	234.4	34.8	97	293.8	43.6
58	57.4	08.5	18	116.7	17.3	78	176.1	26.1	38	235.4	34.9	98	294.8	43.7
59	58.4	08.7	19	117.7	17.5	79	177.1	26.3	39	236.4	35.1	99	295.8	43.9
60	59.3	08.8	20	118.7	17.6	80	178.1	26.4	40	237.4	35.2	300	296.8	44.0
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 7 ¼ Points.

TABLE I. Difference of Latitude and Departure for 1 Point.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.2	61	59.8	11.9	121	118.7	23.6	181	177.5	35.3	241	236.4	47.0
2	02.0	00.4	62	60.8	12.1	22	119.6	23.8	82	178.5	35.5	42	237.4	47.2
3	02.9	00.6	63	61.8	12.3	23	120.6	24.0	83	179.5	35.7	43	238.3	47.4
4	03.9	00.8	64	62.8	12.5	24	121.6	24.2	84	180.5	35.9	44	239.3	47.6
5	04.9	01.0	65	63.8	12.7	25	122.6	24.4	85	181.4	36.1	45	240.3	47.8
6	05.9	01.2	66	64.7	12.9	26	123.6	24.6	86	182.4	36.3	46	241.3	48.0
7	06.9	01.4	67	65.7	13.1	27	124.6	24.8	87	183.4	36.5	47	242.3	48.2
8	07.8	01.6	68	66.7	13.3	28	125.5	25.0	88	184.4	36.7	48	243.2	48.4
9	08.8	01.8	69	67.7	13.5	29	126.5	25.2	89	185.4	36.9	49	244.2	48.6
10	09.8	02.0	70	68.7	13.7	30	127.5	25.4	90	186.3	37.1	50	245.2	48.8
11	10.8	02.1	71	69.6	13.9	131	128.5	25.6	191	187.3	37.3	251	246.2	49.0
12	11.8	02.3	72	70.6	14.0	32	129.5	25.8	92	188.3	37.5	52	247.2	49.2
13	12.8	02.5	78	71.6	14.2	33	130.4	25.9	93	189.3	37.7	53	248.1	49.4
14	13.7	02.7	74	72.6	14.4	34	131.4	26.1	94	190.3	37.8	54	249.1	49.6
15	14.7	02.9	75	73.6	14.6	35	132.4	26.3	95	191.3	38.0	55	250.1	49.7
16	15.7	03.1	76	74.5	14.8	36	133.4	26.5	96	192.2	38.2	56	251.1	49.9
17	16.7	03.3	77	75.5	15.0	37	134.4	26.7	97	193.2	38.4	57	252.1	50.1
18	17.7	03.5	78	76.5	15.2	38	135.3	26.9	98	194.2	38.6	58	253.0	50.3
19	18.6	03.7	79	77.5	15.4	39	136.3	27.1	99	195.2	38.8	59	254.0	50.5
20	19.6	03.9	80	78.5	15.6	40	137.3	27.3	200	196.2	39.0	60	255.0	50.7
21	20.6	04.1	81	79.4	15.8	141	138.3	27.5	201	197.1	39.2	261	256.0	50.9
22	21.6	04.3	82	80.4	16.0	42	139.3	27.7	02	198.1	39.4	62	257.0	51.1
23	22.6	04.5	83	81.4	16.2	43	140.3	27.9	03	199.1	39.6	63	257.9	51.3
24	23.5	04.7	84	82.4	16.4	44	141.2	28.1	04	200.1	39.8	64	258.9	51.5
25	24.5	04.9	85	83.4	16.6	45	142.2	28.3	05	201.1	40.0	65	259.9	51.7
26	25.5	05.1	86	84.3	16.8	46	143.2	28.5	06	202.0	40.2	66	260.9	51.9
27	26.5	05.3	87	85.3	17.0	47	144.2	28.7	07	203.0	40.4	67	261.9	52.1
28	27.5	05.5	88	86.3	17.2	48	145.2	28.9	08	204.0	40.6	68	262.9	52.3
29	28.4	05.7	89	87.3	17.4	49	146.1	29.1	09	205.0	40.8	69	263.8	52.5
30	29.4	05.9	90	88.3	17.6	50	147.1	29.3	10	206.0	41.0	70	264.8	52.7
31	30.4	06.0	91	89.3	17.8	151	148.1	29.5	211	206.9	41.2	271	265.8	52.9
32	31.4	06.2	92	90.2	17.9	52	149.1	29.7	12	207.9	41.4	72	266.8	53.1
33	32.4	06.4	93	91.2	18.1	53	150.1	29.8	13	208.9	41.6	73	267.8	53.3
34	33.3	06.6	94	92.2	18.3	54	151.0	30.0	14	209.9	41.7	74	268.7	53.5
35	34.2	06.8	95	93.2	18.5	55	152.0	30.2	15	210.9	41.9	75	269.7	53.6
36	35.3	07.0	96	94.2	18.7	56	153.0	30.4	16	211.8	42.1	76	270.7	53.8
37	36.3	07.2	97	95.1	18.9	57	154.0	30.6	17	212.8	42.3	77	271.7	54.0
38	37.3	07.4	98	96.1	19.1	58	155.0	30.8	18	213.8	42.5	78	272.7	54.2
39	38.3	07.6	99	97.1	19.3	59	155.9	31.0	19	214.8	42.7	79	273.6	54.4
40	39.2	07.8	100	98.1	19.5	60	156.9	31.2	20	215.8	42.9	80	274.6	54.6
41	40.2	08.0	101	99.1	19.7	161	157.9	31.4	221	216.8	43.1	281	275.6	54.8
42	41.2	08.2	02	100.0	19.9	62	158.9	31.6	22	217.7	43.3	82	276.6	55.0
43	42.2	08.4	03	101.0	20.1	63	159.9	31.8	23	218.7	43.5	83	277.6	55.2
44	43.2	08.6	04	102.0	20.3	64	160.8	32.0	24	219.7	43.7	84	278.5	55.4
45	44.1	08.8	05	103.0	20.5	65	161.8	32.2	25	220.7	43.9	85	279.5	55.6
46	45.1	09.0	06	104.0	20.7	66	162.8	32.4	26	221.7	44.1	86	280.5	55.8
47	46.1	09.2	07	104.9	20.9	67	163.8	32.6	27	222.6	44.3	87	281.5	56.0
48	47.1	09.4	08	105.9	21.1	68	164.8	32.8	28	223.6	44.5	88	282.5	56.2
49	48.1	09.6	09	106.9	21.3	69	165.8	33.0	29	224.6	44.7	89	283.4	56.4
50	49.0	09.8	10	107.9	21.5	70	166.7	33.2	30	225.6	44.9	90	284.4	56.6
51	50.0	09.9	111	108.9	21.7	171	167.7	33.4	231	226.6	45.1	291	285.4	56.8
52	51.0	10.1	12	109.8	21.9	72	168.7	33.6	32	227.5	45.3	92	286.4	57.0
53	52.0	10.3	13	110.8	22.0	73	169.7	33.8	33	228.5	45.5	93	287.4	57.2
54	53.0	10.5	14	111.8	22.2	74	170.7	33.9	34	229.5	45.7	94	288.4	57.4
55	53.9	10.7	15	112.8	22.4	75	171.6	34.1	35	230.5	45.8	95	289.3	57.6
56	54.9	10.9	16	113.8	22.6	76	172.6	34.3	36	231.5	46.0	96	290.3	57.7
57	55.9	11.1	17	114.8	22.8	77	173.6	34.5	37	232.4	46.2	97	291.3	57.9
58	56.9	11.3	18	115.7	23.0	78	174.6	34.7	38	233.4	46.4	98	292.3	58.1
59	57.9	11.5	19	116.7	23.2	79	175.6	34.9	39	234.4	46.6	99	293.3	58.3
60	58.8	11.7	20	117.7	23.4	80	176.5	35.1	40	235.4	46.8	300	294.2	58.5
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 7 Points.

TABLE I. Difference of Latitude and Departure for 1 ¼ Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.2	61	59.2	14.8	121	117.4	29.4	181	175.6	44.0	241	233.8	58.6
2	01.9	00.5	62	60.1	15.1	22	118.3	29.6	82	176.5	44.2	42	234.7	58.8
3	02.9	00.7	63	61.1	15.3	23	119.3	29.9	83	177.5	44.5	43	235.7	59.0
4	03.9	01.0	64	62.1	15.6	24	120.3	30.1	84	178.5	44.7	44	236.7	59.3
5	04.9	01.2	65	63.1	15.8	25	121.3	30.4	85	179.5	45.0	45	237.7	59.5
6	05.8	01.5	66	64.0	16.0	26	122.2	30.6	86	180.4	45.2	46	238.6	59.8
7	06.8	01.7	67	65.0	16.3	27	123.2	30.9	87	181.4	45.4	47	239.6	60.0
8	07.8	01.9	68	66.0	16.5	28	124.2	31.1	88	182.4	45.7	48	240.6	60.3
9	08.7	02.2	69	66.9	16.8	29	125.1	31.3	89	183.3	45.9	49	241.5	60.5
10	09.7	02.4	70	67.9	17.0	30	126.1	31.6	90	184.3	46.2	50	242.5	60.7
11	10.7	02.7	71	68.9	17.3	131	127.1	31.8	191	185.3	46.4	251	243.5	61.0
12	11.6	02.9	72	69.8	17.5	32	128.0	32.1	92	186.2	46.7	52	244.4	61.2
13	12.6	03.2	73	70.8	17.7	33	129.0	32.3	93	187.2	46.9	53	245.4	61.5
14	13.6	03.4	74	71.8	18.0	34	130.0	32.6	94	188.2	47.1	54	246.4	61.7
15	14.6	03.6	75	72.8	18.2	35	131.0	32.8	95	189.2	47.4	55	247.4	62.0
16	15.5	03.9	76	73.7	18.5	36	131.9	33.0	96	190.1	47.6	56	248.3	62.2
17	16.5	04.1	77	74.7	18.7	37	132.9	33.3	97	191.1	47.9	57	249.3	62.4
18	17.5	04.4	78	75.7	19.0	38	133.9	33.5	98	192.1	48.1	58	250.3	62.7
19	18.4	04.6	79	76.6	19.2	39	134.8	33.8	99	193.0	48.4	59	251.2	62.9
20	19.4	04.9	80	77.6	19.4	40	135.8	34.0	200	194.0	48.6	60	252.2	63.2
21	20.4	05.1	81	78.6	19.7	141	136.8	34.3	201	195.0	48.8	261	253.2	63.4
22	21.3	05.3	82	79.5	19.9	42	137.7	34.5	02	195.9	49.1	62	254.1	63.7
23	22.3	05.6	83	80.5	20.2	43	138.7	34.7	03	196.9	49.3	63	255.1	63.9
24	23.3	05.8	84	81.5	20.4	44	139.7	35.0	04	197.9	49.6	64	256.1	64.1
25	24.3	06.1	85	82.5	20.7	45	140.7	35.2	05	198.9	49.8	65	257.1	64.4
26	25.2	06.3	86	83.4	20.9	46	141.6	35.5	06	199.8	50.1	66	258.0	64.6
27	26.2	06.6	87	84.4	21.1	47	142.6	35.7	07	200.8	50.3	67	259.0	64.9
28	27.2	06.8	88	85.4	21.4	48	143.6	36.0	08	201.8	50.5	68	260.0	65.1
29	28.1	07.0	89	86.3	21.6	49	144.5	36.2	09	202.7	50.8	69	260.9	65.4
30	29.1	07.3	90	87.3	21.9	50	145.5	36.4	10	203.7	51.0	70	261.9	65.6
31	30.1	07.5	91	88.3	22.1	151	146.5	36.7	211	204.7	51.3	271	262.9	65.8
32	31.0	07.8	92	89.2	22.4	52	147.4	36.9	12	205.6	51.5	72	263.8	66.1
33	32.0	08.0	93	90.2	22.6	53	148.4	37.2	13	206.6	51.8	73	264.8	66.3
34	33.0	08.3	94	91.2	22.8	54	149.4	37.4	14	207.6	52.0	74	265.8	66.6
35	34.0	08.5	95	92.2	23.1	55	150.4	37.7	15	208.6	52.2	75	266.8	66.8
36	34.9	08.7	96	93.1	23.3	56	151.3	37.9	16	209.5	52.5	76	267.7	67.1
37	35.9	09.0	97	94.1	23.6	57	152.3	38.1	17	210.5	52.7	77	268.7	67.3
38	36.9	09.2	98	95.1	23.8	58	153.3	38.4	18	211.5	53.0	78	269.7	67.5
39	37.8	09.5	99	96.0	24.1	59	154.2	38.6	19	212.4	53.2	79	270.6	67.8
40	38.8	09.7	100	97.0	24.3	60	155.2	38.9	20	213.4	53.5	80	271.6	68.0
41	39.8	10.0	101	98.0	24.5	161	156.2	39.1	221	214.4	53.7	281	272.6	68.3
42	40.7	10.2	02	98.9	24.8	62	157.1	39.4	22	215.3	53.9	82	273.5	68.5
43	41.7	10.4	03	99.9	25.0	63	158.1	39.6	23	216.3	54.2	83	274.5	68.8
44	42.7	10.7	04	100.9	25.3	64	159.1	39.8	24	217.3	54.4	84	275.5	69.0
45	43.7	10.9	05	101.9	25.5	65	160.1	40.1	25	218.3	54.7	85	276.5	69.2
46	44.6	11.2	06	102.8	25.8	66	161.0	40.3	26	219.2	54.9	86	277.4	69.5
47	45.6	11.4	07	103.8	26.0	67	162.0	40.6	27	220.2	55.2	87	278.4	69.7
48	46.6	11.7	08	104.8	26.2	68	163.0	40.8	28	221.2	55.4	88	279.4	70.0
49	47.5	11.9	09	105.7	26.5	69	163.9	41.1	29	222.1	55.6	89	280.3	70.2
50	48.5	12.1	10	106.7	26.7	70	164.9	41.3	30	223.1	55.9	90	281.3	70.5
51	49.5	12.4	111	107.7	27.0	171	165.9	41.5	231	224.1	56.1	291	282.3	70.7
52	50.4	12.6	12	108.6	27.2	72	166.8	41.8	32	225.0	56.4	92	283.2	71.0
53	51.4	12.9	13	109.6	27.5	73	167.8	42.0	33	226.0	56.6	93	284.2	71.2
54	52.4	13.1	14	110.6	27.7	74	168.8	42.3	34	227.0	56.9	94	285.2	71.4
55	53.4	13.4	15	111.6	27.9	75	169.8	42.5	35	228.0	57.1	95	286.2	71.7
56	54.3	13.6	16	112.5	28.2	76	170.7	42.8	36	228.9	57.3	96	287.1	71.9
57	55.3	13.8	17	113.5	28.4	77	171.7	43.0	37	229.9	57.6	97	288.1	72.2
58	56.3	14.1	18	114.5	28.7	78	172.7	43.3	38	230.9	57.8	98	289.1	72.4
59	57.2	14.3	19	115.4	28.9	79	173.6	43.5	39	231.8	58.1	99	290.0	72.7
60	58.2	14.6	20	116.4	29.2	80	174.6	43.7	40	232.8	58.3	300	291.0	72.9
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 6 ¾ Points.

TABLE I. Difference of Latitude and Departure for 1 ½ Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.3	61	58.4	17.7	121	115.8	35.1	181	173.2	52.5	241	230.6	70.0
2	01.9	00.6	62	59.3	18.0	22	116.7	35.4	82	174.2	52.8	42	231.6	70.2
3	02.9	00.9	63	60.3	18.3	23	117.7	35.7	83	175.1	53.1	43	232.5	70.5
4	03.8	01.2	64	61.2	18.6	24	118.7	36.0	84	176.1	53.4	44	233.5	70.8
5	04.8	01.5	65	62.2	18.9	25	119.6	36.3	85	177.0	53.7	45	234.5	71.1
6	05.7	01.7	66	63.2	19.2	26	120.6	36.6	86	178.0	54.0	46	235.4	71.4
7	06.7	02.0	67	64.1	19.4	27	121.5	36.9	87	179.0	54.3	47	236.4	71.7
8	07.7	02.3	68	65.1	19.7	28	122.5	37.2	88	179.9	54.6	48	237.3	72.0
9	08.6	02.6	69	66.0	20.0	29	123.4	37.4	89	180.9	54.9	49	238.3	72.3
10	09.6	02.9	70	67.0	20.3	30	124.4	37.7	90	181.8	55.0	50	239.2	72.6
11	10.5	03.2	71	67.9	20.6	131	125.4	38.0	191	182.8	55.4	251	240.2	72.9
12	11.5	03.5	72	68.9	20.9	32	126.3	38.3	92	183.7	55.7	52	241.1	73.2
13	12.4	03.8	73	69.9	21.2	33	127.3	38.6	93	184.7	56.0	53	242.1	73.4
14	13.4	04.1	74	70.8	21.5	34	128.2	38.9	94	185.6	56.3	54	243.1	73.7
15	14.4	04.4	75	71.8	21.8	35	129.2	39.2	95	186.6	56.6	55	244.0	74.0
16	15.3	04.6	76	72.7	22.1	36	130.1	39.5	96	187.6	56.9	56	245.0	74.3
17	16.3	04.9	77	73.7	22.4	37	131.1	39.8	97	188.5	57.2	57	245.9	74.6
18	17.2	05.2	78	74.6	22.6	38	132.1	40.0	98	189.5	57.5	58	246.9	74.9
19	18.2	05.5	79	75.6	22.9	39	133.0	40.3	99	190.4	57.8	59	247.8	75.2
20	19.1	05.8	80	76.6	23.2	40	134.0	40.6	200	191.4	58.1	60	248.8	75.5
21	20.1	06.1	81	77.5	23.5	141	134.9	40.9	201	192.3	58.3	261	249.8	75.8
22	21.1	06.4	82	78.5	23.8	42	135.9	41.2	02	193.3	58.6	62	250.7	76.1
23	22.0	06.7	83	79.4	24.1	43	136.8	41.5	03	194.3	58.9	63	251.7	76.3
24	23.0	07.0	84	80.4	24.4	44	137.8	41.8	04	195.2	59.2	64	252.6	76.6
25	23.9	07.3	85	81.3	24.7	45	138.8	42.1	05	196.2	59.5	65	253.6	76.9
26	24.9	07.5	86	82.3	25.0	46	139.7	42.4	06	197.1	59.8	66	254.5	77.2
27	25.9	07.8	87	83.3	25.2	47	140.7	42.7	07	198.1	60.1	67	255.5	77.5
28	26.8	08.1	88	84.2	25.5	48	141.6	43.0	08	199.0	60.4	68	256.5	77.8
29	27.8	08.4	89	85.2	25.8	49	142.6	43.3	09	200.0	60.7	69	257.4	78.1
30	28.7	08.7	90	86.1	26.1	50	143.5	43.5	10	201.0	61.0	70	258.4	78.4
31	29.7	09.0	91	87.1	26.4	151	144.5	43.8	211	201.9	61.2	271	259.3	78.7
32	30.6	09.3	92	88.0	26.7	52	145.5	44.1	12	202.9	61.5	72	260.3	78.9
33	31.6	09.6	93	89.0	27.0	53	146.4	44.4	13	203.8	61.8	73	261.2	79.2
34	32.5	09.9	94	90.0	27.3	54	147.4	44.7	14	204.8	62.1	74	262.2	79.5
35	33.5	10.2	95	90.9	27.6	55	148.3	45.0	15	205.7	62.4	75	263.2	79.8
36	34.5	10.4	96	91.9	27.8	56	149.3	45.3	16	206.7	62.7	76	264.1	80.1
37	35.4	10.7	97	92.8	28.2	57	150.2	45.6	17	207.7	63.0	77	265.1	80.4
38	36.4	11.0	98	93.8	28.4	58	151.2	45.9	18	208.6	63.3	78	266.0	80.7
39	37.3	11.3	99	94.7	28.7	59	152.2	46.2	19	209.6	63.6	79	267.0	80.9
40	38.3	11.6	100	95.7	29.0	60	153.1	46.4	20	210.5	63.9	80	267.9	81.3
41	39.2	11.9	101	96.7	29.3	161	154.1	46.7	221	211.5	64.2	281	268.9	81.6
42	40.2	12.2	02	97.6	29.6	62	155.0	47.0	22	212.4	64.4	82	269.9	81.9
43	41.1	12.5	03	98.6	29.9	63	156.0	47.3	23	213.4	64.7	83	270.8	82.2
44	42.1	12.8	04	99.5	30.2	64	156.9	47.6	24	214.4	65.0	84	271.8	82.4
45	43.1	13.1	05	100.5	30.5	65	157.9	47.9	25	215.3	65.3	85	272.7	82.7
46	44.0	13.3	06	101.4	30.8	66	158.9	48.2	26	216.3	65.6	86	273.7	83.0
47	45.0	13.6	07	102.4	31.1	67	159.8	48.5	27	217.2	65.9	87	274.6	83.3
48	45.9	13.9	08	103.3	31.4	68	160.8	48.8	28	218.2	66.2	88	275.6	83.6
49	46.9	14.2	09	104.3	31.6	69	161.7	49.0	29	219.1	66.4	89	276.6	83.9
50	47.8	14.5	10	105.3	31.9	70	162.7	49.3	30	220.1	66.8	90	277.5	84.2
51	48.8	14.8	111	106.2	32.2	171	163.6	49.6	231	221.1	67.1	291	278.5	84.5
52	49.8	15.1	12	107.2	32.5	72	164.6	49.9	32	222.0	67.3	92	279.4	84.8
53	50.7	15.4	13	108.1	32.8	73	165.6	50.2	33	223.0	67.6	93	280.4	85.0
54	51.7	15.7	14	109.1	33.1	74	166.5	50.5	34	223.9	67.9	94	281.3	85.3
55	52.6	16.0	15	110.0	33.4	75	167.5	50.8	35	224.9	68.2	95	282.3	85.6
56	53.6	16.3	16	111.0	33.8	76	168.4	51.1	36	225.9	68.5	96	283.3	85.9
57	54.5	16.5	17	112.0	34.0	77	169.4	51.4	37	226.8	68.8	97	284.2	86.2
58	55.5	16.8	18	112.9	34.3	78	170.3	51.7	38	227.8	69.1	98	285.2	86.5
59	56.5	17.1	19	113.9	34.5	79	171.3	52.0	39	228.7	69.4	99	286.1	86.8
60	57.4	17.4	20	114.8	34.8	80	172.3	52.3	40	229.7	69.7	300	287.1	87.1
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 6 ½ Points.

TABLE I. Difference of Latitude and Departure for ¼ Point.

Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
01.0	00.0	61	60.9	03.0	121	120.9	05.9	181	180.8	08.9	241	240.7	11.8
02.0	00.1	62	61.9	03.0	22	121.9	06.0	82	181.8	08.9	42	241.7	11.9
03.0	00.1	63	62.9	03.1	23	122.9	06.0	83	182.8	09.0	43	242.7	11.9
04.0	00.2	64	63.9	03.1	24	123.9	06.1	84	183.8	09.0	44	243.7	12.0
05.0	00.2	65	64.9	03.2	25	124.8	06.1	85	184.8	09.1	45	244.7	12.0
06.0	00.3	66	65.9	03.2	26	125.8	06.2	86	185.8	09.1	46	245.7	12.1
07.0	00.3	67	66.9	03.3	27	126.8	06.2	87	186.8	09.2	47	246.7	12.1
08.0	00.4	68	67.9	03.3	28	127.8	06.3	88	187.8	09.2	48	247.7	12.2
09.0	00.4	69	68.9	03.4	29	128.8	06.3	89	188.8	09.3	49	248.7	12.2
10.0	00.5	70	69.9	03.4	30	129.8	06.4	90	189.8	09.3	50	249.7	12.3
11.0	00.5	71	70.9	03.5	131	130.8	06.4	191	190.8	09.4	251	250.7	12.3
12.0	00.6	72	71.9	03.5	32	131.8	06.5	92	191.8	09.4	52	251.7	12.4
13.0	00.6	73	72.9	03.6	33	132.8	06.5	93	192.8	09.5	53	252.7	12.4
14.0	00.7	74	73.9	03.6	34	133.8	06.6	94	193.8	09.5	54	253.7	12.5
15.0	00.7	75	74.9	03.7	35	134.8	06.6	95	194.8	09.6	55	254.7	12.5
16.0	00.8	76	75.9	03.7	36	135.8	06.7	96	195.8	09.6	56	255.7	12.6
17.0	00.8	77	76.9	03.8	37	136.8	06.7	97	196.8	09.7	57	256.7	12.6
18.0	00.9	78	77.9	03.8	38	137.8	06.8	98	197.8	09.7	58	257.7	12.7
19.0	00.9	79	78.9	03.9	39	138.8	06.8	99	198.8	09.8	59	258.7	12.7
20.0	01.0	80	79.9	03.9	40	139.8	06.9	200	199.8	09.8	60	259.7	12.8
21.0	01.0	81	80.9	04.0	141	140.8	06.9	201	200.8	09.9	261	260.7	12.8
22.0	01.1	82	81.9	04.0	42	141.8	07.0	02	201.8	09.9	62	261.7	12.9
23.0	01.1	83	82.9	04.1	43	142.8	07.0	03	202.8	10.0	63	262.7	12.9
24.0	01.2	84	83.9	04.1	44	143.8	07.1	04	203.8	10.0	64	263.7	13.0
25.0	01.2	85	84.9	04.2	45	144.8	07.1	05	204.8	10.1	65	264.7	13.0
26.0	01.3	86	85.9	04.2	46	145.8	07.2	06	205.8	10.1	66	265.7	13.1
27.0	01.3	87	86.9	04.3	47	146.8	07.2	07	206.8	10.2	67	266.7	13.1
28.0	01.4	88	87.9	04.3	48	147.8	07.3	08	207.7	10.2	68	267.7	13.2
29.0	01.4	89	88.9	04.4	49	148.8	07.3	09	208.7	10.3	69	268.7	13.2
30.0	01.5	90	89.9	04.4	50	149.8	07.4	10	209.7	10.3	70	269.7	13.2
31.0	01.5	91	90.9	04.5	151	150.8	07.4	211	210.7	10.4	271	270.7	13.3
42.0	01.6	92	91.9	04.5	52	151.8	07.5	12	211.7	10.4	72	271.7	13.3
33.0	01.6	93	92.9	04.6	53	152.8	07.5	13	212.7	10.5	73	272.7	13.4
34.0	01.7	94	93.9	04.6	54	153.8	07.6	14	213.7	10.5	74	273.7	13.4
35.0	01.7	95	94.9	04.7	55	154.8	07.6	15	214.7	10.5	75	274.7	13.5
36.0	01.8	96	95.9	04.7	56	155.8	07.7	16	215.7	10.6	76	275.7	13.5
37.0	01.8	97	96.9	04.8	57	156.8	07.7	17	216.7	10.6	77	276.7	13.6
38.0	01.9	98	97.9	04.8	58	157.8	07.8	18	217.7	10.7	78	277.7	13.6
39.0	01.9	99	98.9	04.9	59	158.8	07.8	19	218.7	10.7	79	278.7	13.7
40.0	02.0	100	99.9	04.9	60	159.8	07.9	20	219.7	10.8	80	279.7	13.7
41.0	02.0	101	100.9	05.0	161	160.8	07.9	221	220.7	10.8	281	280.7	13.8
41.9	02.1	02	101.9	05.0	62	161.8	08.0	22	221.7	10.9	82	281.7	13.8
42.9	02.1	03	102.9	05.1	63	162.8	08.0	23	222.7	10.9	83	282.7	13.9
43.9	02.2	04	103.9	05.1	64	163.8	08.1	24	223.7	11.0	84	283.7	13.9
44.9	02.2	05	104.9	05.2	65	164.8	08.1	25	224.7	11.0	85	284.7	14.0
45.9	02.3	06	105.9	05.2	66	165.8	08.1	26	225.7	11.1	86	285.7	14.0
46.9	02.3	07	106.9	05.3	67	166.8	08.2	27	226.7	11.1	87	286.7	14.1
47.9	02.4	08	107.9	05.3	68	167.8	08.2	28	227.7	11.2	88	287.7	14.1
48.9	02.4	09	108.9	05.4	69	168.8	08.3	29	228.7	11.2	89	288.7	14.2
49.9	02.5	10	109.9	05.4	70	169.8	08.3	30	229.7	11.3	90	289.7	14.2
50.9	02.5	111	110.9	05.4	171	170.8	08.4	231	230.7	11.3	291	290.7	14.3
51.9	02.6	12	111.9	05.5	72	171.8	08.4	32	231.7	11.4	92	291.6	14.3
52.9	02.6	13	112.9	05.5	73	172.8	08.5	33	232.7	11.4	93	292.6	14.4
53.9	02.7	14	113.9	05.6	74	173.8	08.5	34	233.7	11.5	94	293.6	14.4
54.9	02.7	15	114.9	05.6	75	174.8	08.6	35	234.7	11.5	95	294.6	14.5
55.9	02.7	16	115.9	05.7	76	175.8	08.6	36	235.7	11.6	96	295.6	14.5
56.9	02.8	17	116.9	05.7	77	176.8	08.7	37	236.7	11.6	97	296.6	14.6
57.9	02.8	18	117.9	05.8	78	177.8	08.7	38	237.7	11.7	98	297.6	14.6
58.9	02.9	19	118.9	05.8	79	178.8	08.8	39	238.7	11.7	99	298.6	14.7
59.9	02.9	20	119.9	05.9	80	179.8	08.8	40	239.7	11.8	300	299.6	14.7
Dep	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 7 ¾ Points.

TABLE I. Difference of Latitude and Departure for 2 Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.4	61	56.4	23.3	121	111.8	46.3	181	167.2	69.3	241	222.7	92.2
2	01.8	00.8	62	57.3	23.7	22	112.7	46.7	82	168.1	69.7	42	223.6	92.6
3	02.8	01.1	63	58.2	24.1	23	113.6	47.1	83	169.1	70.0	43	224.5	93.0
4	03.7	01.5	64	59.1	24.5	24	114.6	47.5	84	170.0	70.4	44	225.4	93.4
5	04.6	01.9	65	60.1	24.9	25	115.5	47.8	85	170.9	70.8	45	226.4	93.8
6	05.5	02.3	66	61.0	25.3	26	116.4	48.2	86	171.9	71.2	46	227.3	94.1
7	06.5	02.7	67	61.9	25.6	27	117.3	48.6	87	172.8	71.6	47	228.2	94.5
8	07.4	03.1	68	62.8	26.0	28	118.3	49.0	88	173.7	71.9	48	229.1	94.9
9	08.3	03.4	69	63.7	26.4	29	119.2	49.4	89	174.6	72.3	49	230.1	95.3
10	09.2	03.8	70	64.7	26.8	30	120.1	49.7	90	175.5	72.7	50	231.0	95.7
11	10.2	04.2	71	65.6	27.2	131	121.0	50.1	191	176.5	73.1	251	231.9	96.1
12	11.1	04.6	72	66.5	27.6	32	122.0	50.5	92	177.4	73.5	52	232.8	96.4
13	12.0	05.0	73	67.4	27.9	33	122.9	50.9	93	178.3	73.9	53	233.7	96.8
14	12.9	05.4	74	68.4	28.3	34	123.8	51.3	94	179.2	74.2	54	234.7	97.2
15	13.9	05.7	75	69.3	28.7	35	124.7	51.7	95	180.2	74.6	55	235.6	97.6
16	14.8	06.1	76	70.2	29.1	36	125.6	52.0	96	181.1	75.0	56	236.5	98.0
17	15.7	06.5	77	71.1	29.5	37	126.6	52.4	97	182.0	75.4	57	237.4	98.3
18	16.6	06.9	78	72.1	29.8	38	127.5	52.8	98	182.9	75.8	58	238.4	98.7
19	17.6	07.3	79	73.0	30.2	39	128.4	53.2	99	183.9	76.2	59	239.3	99.1
20	18.5	07.7	80	73.9	30.6	40	129.3	53.6	200	184.8	76.5	60	240.2	99.5
21	19.4	08.0	81	74.8	31.0	141	130.3	54.0	201	185.7	76.9	261	241.1	99.9
22	20.3	08.4	82	75.8	31.4	42	131.2	54.3	02	186.6	77.3	62	242.1	100.3
23	21.2	08.8	83	76.7	31.8	43	132.1	54.7	03	187.5	77.7	63	243.0	100.6
24	22.2	09.2	84	77.6	32.1	44	133.0	55.1	04	188.5	78.1	64	243.9	101.0
25	23.1	09.6	85	78.5	32.5	45	134.0	55.5	05	189.4	78.5	65	244.8	101.4
26	24.0	10.0	86	79.5	32.9	46	134.9	55.9	06	190.3	78.8	66	245.8	101.8
27	24.9	10.3	87	80.4	33.3	47	135.8	56.3	07	191.2	79.2	67	246.7	102.2
28	25.9	10.7	88	81.3	33.7	48	136.7	56.6	08	192.2	79.6	68	247.6	102.6
29	26.8	11.1	89	82.2	34.1	49	137.7	57.0	09	193.1	80.0	69	248.5	102.9
30	27.7	11.5	90	83.1	34.4	50	138.6	57.4	10	194.0	80.4	70	249.4	103.3
31	28.6	11.9	91	84.1	34.8	151	139.5	57.8	211	194.9	80.7	271	250.4	103.7
32	29.6	12.2	92	85.0	35.2	52	140.4	58.2	12	195.9	81.1	72	251.3	104.1
33	30.5	12.6	93	85.9	35.6	53	141.4	58.6	13	196.8	81.5	73	252.2	104.5
34	31.4	13.0	94	86.8	36.0	54	142.3	58.9	14	197.7	81.9	74	253.1	104.9
35	32.3	13.4	95	87.8	36.4	55	143.2	59.3	15	198.6	82.3	75	254.1	105.2
36	33.3	13.8	96	88.7	36.7	56	144.1	59.7	16	199.6	82.7	76	255.0	105.6
37	34.2	14.2	97	89.6	37.1	57	145.0	60.1	17	200.5	83.0	77	255.9	106.0
38	35.1	14.5	98	90.5	37.5	58	146.0	60.5	18	201.4	83.4	78	256.8	106.4
39	36.0	14.9	99	91.5	37.9	59	146.9	60.8	19	202.3	83.8	79	257.8	106.8
40	37.0	15.3	100	92.4	38.3	60	147.8	61.2	20	203.3	84.2	80	258.7	107.2
41	37.9	15.7	101	93.3	38.7	161	148.7	61.6	221	204.2	84.6	281	259.6	107.5
42	38.8	16.1	02	94.2	39.0	62	149.7	62.0	22	205.1	85.0	82	260.5	107.9
43	39.7	16.5	03	95.2	39.4	63	150.6	62.4	23	206.0	85.3	83	261.5	108.3
44	40.6	16.8	04	96.1	39.8	64	151.5	62.8	24	206.9	85.7	84	262.4	108.7
45	41.6	17.2	05	97.0	40.2	65	152.4	63.1	25	207.9	86.1	85	263.3	109.1
46	42.5	17.6	06	97.9	40.6	66	153.4	63.5	26	208.8	86.5	86	264.2	109.4
47	43.4	18.0	07	98.9	40.9	67	154.3	63.9	27	209.7	86.9	87	265.2	109.8
48	44.3	18.4	08	99.8	41.3	68	155.2	64.3	28	210.6	87.3	88	266.1	110.2
49	45.3	18.8	09	100.7	41.7	69	156.1	64.7	29	211.6	87.6	89	267.0	110.6
50	46.2	19.1	10	101.6	42.1	70	157.1	65.1	30	212.5	88.0	90	267.9	111.0
51	47.1	19.5	111	102.6	42.5	171	158.0	65.4	231	213.4	88.4	291	268.8	111.4
52	48.0	19.9	12	103.5	42.9	72	158.9	65.8	32	214.3	88.8	92	269.8	111.7
53	49.0	20.3	13	104.4	43.2	73	159.8	66.2	33	215.2	89.2	93	270.7	112.1
54	49.9	20.7	14	105.3	43.6	74	160.8	66.6	34	216.2	89.6	94	271.6	112.5
55	50.8	21.0	15	106.3	44.0	75	161.7	67.0	35	217.1	89.9	95	272.5	112.9
56	51.7	21.4	16	107.2	44.4	76	162.6	67.4	36	218.0	90.3	96	273.5	113.3
57	52.7	21.8	17	108.1	44.8	77	163.5	67.7	37	219.0	90.7	97	274.4	113.7
58	53.6	22.2	18	109.0	45.2	78	164.5	68.1	38	219.9	91.1	98	275.3	114.0
59	54.5	22.6	19	109.9	45.5	79	165.4	68.5	39	220.8	91.5	99	276.2	114.4
60	55.4	23.0	20	110.9	45.9	80	166.3	68.9	40	221.7	91.8	300	277.2	114.8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 6 Points.

TABLE I. Difference of Latitude and Departure for ¾ Point.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.1	61	60.3	09.0	121	119.7	17.8	181	179.0	26.5	241	238.4	35.4
2	02.0	00.3	62	61.3	09.1	22	120.7	17.8	82	180.0	26.7	42	239.4	35.5
3	03.0	00.4	63	62.3	09.2	23	121.7	18.0	83	181.0	26.8	43	240.4	35.7
4	04.0	00.6	64	63.3	09.4	24	122.7	18.2	84	182.0	27.0	44	241.3	35.8
5	04.9	00.7	65	64.3	09.5	25	123.6	18.3	85	183.0	27.1	45	242.3	35.9
6	05.9	00.9	66	65.3	09.7	26	124.6	18.5	86	184.0	27.3	46	243.3	35.1
7	06.9	01.0	67	66.3	09.8	27	125.6	18.6	87	185.0	27.4	47	244.3	36.2
8	07.9	01.2	68	67.3	10.0	28	126.6	18.8	88	186.0	27.6	48	245.3	36.4
9	08.9	01.3	69	68.3	10.1	29	127.6	18.9	89	187.0	27.7	49	246.3	36.5
10	09.9	01.5	70	69.2	10.3	30	128.6	19.1	90	187.9	27.9	50	247.3	36.7
11	10.9	01.6	71	70.2	10.4	131	129.6	19.2	191	188.9	28.0	251	248.3	36.8
12	11.9	01.8	72	71.2	10.6	32	130.6	19.4	92	189.9	28.2	52	249.3	37.0
13	12.9	01.9	73	72.2	10.7	33	131.6	19.5	93	190.9	28.3	53	250.3	37.1
14	13.8	02.1	74	73.2	10.9	34	132.5	19.7	94	191.9	28.5	54	251.3	37.3
15	14.8	02.2	75	74.2	11.0	35	133.5	19.8	95	192.9	28.6	55	252.2	37.4
16	15.8	02.3	76	75.2	11.2	36	134.5	20.0	96	193.9	28.7	56	253.2	37.6
17	16.8	02.5	77	76.2	11.3	37	135.5	20.1	97	194.9	28.9	57	254.2	37.7
18	17.8	02.6	78	77.2	11.4	38	136.5	20.2	98	195.9	29.0	58	255.2	37.9
19	18.8	02.8	79	78.1	11.6	39	137.5	20.4	99	196.8	29.2	59	256.2	38.0
20	19.8	02.9	80	79.1	11.7	40	138.5	20.5	200	197.8	29.3	60	257.2	38.1
21	20.8	03.1	81	80.1	11.9	141	139.5	20.7	201	198.8	29.5	261	258.2	38.3
22	21.8	03.2	82	81.1	12.0	42	140.5	20.8	02	199.8	29.6	62	259.2	38.4
23	22.8	03.4	83	82.1	12.2	43	141.5	21.0	03	200.8	29.8	63	260.2	38.6
24	23.7	03.5	84	83.1	12.3	44	142.4	21.1	04	201.8	29.9	64	261.1	38.7
25	24.7	03.7	85	84.1	12.5	45	143.4	21.3	05	202.8	30.1	65	262.1	38.9
26	25.7	03.8	86	85.1	12.6	46	144.4	21.4	06	203.8	30.2	66	263.1	39.0
27	26.7	04.0	87	86.1	12.8	47	145.4	21.6	07	204.8	30.4	67	264.1	39.2
28	27.7	04.1	88	87.0	12.9	48	146.4	21.7	08	205.7	30.5	68	265.1	39.3
29	28.7	04.3	89	88.0	13.0	49	147.4	21.9	09	206.7	30.7	69	266.1	39.5
30	29.7	04.4	90	89.0	13.2	50	148.4	22.0	10	207.7	30.8	70	267.1	39.6
31	30.7	04.5	91	90.0	13.4	151	149.4	22.2	211	208.7	31.0	271	268.1	39.8
32	31.7	04.7	92	91.0	13.5	52	150.4	22.3	12	209.7	31.1	72	269.1	39.9
33	32.6	04.8	93	92.0	13.6	53	151.3	22.4	13	210.7	31.2	73	270.0	40.1
34	33.6	05.0	94	93.0	13.8	54	152.3	22.6	14	211.7	31.4	74	271.0	40.2
35	34.6	05.1	95	94.0	13.9	55	153.3	22.7	15	212.7	31.5	75	272.0	40.4
36	35.6	05.3	96	95.0	14.1	56	154.3	22.9	16	213.7	31.7	76	273.0	40.5
37	36.6	05.4	97	95.9	14.2	57	155.3	23.0	17	214.7	31.8	77	274.0	40.6
38	37.6	05.6	98	96.9	14.4	58	156.3	23.2	18	215.6	32.0	78	275.0	40.8
39	38.6	05.7	99	97.9	14.5	59	157.3	23.3	19	216.6	32.1	79	276.0	40.9
40	39.6	05.9	100	98.9	14.7	60	158.3	23.5	20	217.6	32.3	80	277.0	41.1
41	40.6	06.0	101	99.9	14.8	161	159.3	23.6	221	218.6	32.4	281	278.0	41.2
42	41.5	06.2	02	100.9	15.0	62	160.2	23.8	22	219.6	32.6	82	278.9	41.4
43	42.5	06.3	03	101.9	15.1	63	161.2	23.9	23	220.6	32.7	83	279.9	41.6
44	43.5	06.5	04	102.9	15.3	64	162.2	24.1	24	221.6	32.9	84	280.9	41.7
45	44.5	06.6	05	103.9	15.4	65	163.2	24.2	25	222.6	33.0	85	281.9	41.8
46	45.5	06.7	06	104.9	15.6	66	164.2	24.4	26	223.6	33.2	86	282.9	42.0
47	46.5	06.9	07	105.8	15.7	67	165.2	24.5	27	224.5	33.3	87	283.9	42.1
48	47.5	07.0	08	106.8	15.8	68	166.2	24.7	28	225.5	33.5	88	284.9	42.3
49	48.5	07.2	09	107.8	16.0	69	167.2	24.8	29	226.5	33.6	89	285.9	42.4
50	49.5	07.3	10	108.8	16.1	70	168.2	24.9	30	227.5	33.7	90	286.9	42.6
51	50.4	07.5	111	109.8	16.3	171	169.1	25.1	231	228.5	33.9	291	287.9	42.7
52	51.4	07.6	12	110.8	16.4	72	170.1	25.2	32	229.5	34.0	92	288.8	42.8
53	52.4	07.8	13	111.8	16.6	73	171.1	25.4	33	230.5	34.2	93	289.8	43.0
54	53.4	07.9	14	112.8	16.7	74	172.1	25.5	34	231.5	34.3	94	290.8	43.1
55	54.4	08.1	15	113.8	16.9	75	173.1	25.7	35	232.5	34.5	95	291.8	43.3
56	55.4	08.2	16	114.7	17.0	76	174.1	25.8	36	233.4	34.6	96	292.8	43.4
57	56.4	08.4	17	115.7	17.2	77	175.1	26.0	37	234.4	34.8	97	293.8	43.6
58	57.4	08.5	18	116.7	17.3	78	176.1	26.1	38	235.4	34.9	98	294.8	43.7
59	58.4	08.7	19	117.7	17.5	79	177.1	26.3	39	236.4	35.1	99	295.8	43.9
60	59.3	08.8	20	118.7	17.6	80	178.1	26.4	40	237.4	35.2	300	296.8	44.0
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 7 ¼ Points.

TABLE I. Difference of Latitude and Departure for 2 ½ Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.5	61	53.8	28.8	121	106.7	57.0	181	159.6	85.3	241	212.5	113.6
2	01.8	00.9	62	54.7	29.2	22	107.6	57.5	82	160.5	85.8	42	213.4	114.1
3	02.6	01.4	63	55.6	29.7	23	108.5	58.0	83	161.4	86.3	43	214.3	114.5
4	03.5	01.9	64	56.4	30.2	24	109.4	58.5	84	162.3	86.7	44	215.2	115.0
5	04.4	02.4	65	57.3	30.6	25	110.2	58.9	85	163.2	87.2	45	216.1	115.8
6	05.3	02.8	66	58.2	31.1	26	111.1	59.4	86	164.0	87.7	46	217.0	116.0
7	06.2	03.3	67	59.1	31.6	27	112.0	59.9	87	164.9	88.2	47	217.8	116.4
8	07.1	03.8	68	60.0	32.0	28	112.9	60.3	88	165.8	88.6	48	218.7	116.9
9	07.9	04.2	69	60.9	32.5	29	113.8	60.8	89	166.7	89.1	49	219.6	117.4
10	08.8	04.7	70	61.7	33.0	30	114.6	61.3	90	167.6	89.6	50	220.5	117.8
11	09.7	05.2	71	62.6	33.5	131	115.5	61.8	191	168.4	90.0	251	221.4	118.3
12	10.6	05.7	72	63.5	33.9	32	116.4	62.2	92	169.3	90.5	52	222.2	118.7
13	11.5	06.1	73	64.4	34.4	33	117.3	62.7	93	170.2	91.0	53	223.1	119.3
14	12.3	06.6	74	65.3	34.9	34	118.2	63.2	94	171.1	91.4	54	224.0	119.7
15	13.2	07.1	75	66.1	35.4	35	119.1	63.6	95	172.0	91.9	55	224.9	120.2
16	14.1	07.5	76	67.0	35.8	36	119.9	64.1	96	172.9	92.4	56	225.8	120.7
17	15.0	08.0	77	67.9	36.3	37	120.8	64.6	97	173.7	92.9	57	226.7	121.1
18	15.9	08.5	78	68.8	36.8	38	121.7	65.1	98	174.6	93.3	58	227.5	121.6
19	16.8	09.0	79	69.7	37.2	39	122.6	65.5	99	175.5	93.8	59	228.4	122.1
20	17.6	09.4	80	70.6	37.7	40	123.5	66.0	200	176.4	94.3	60	229.3	122.6
21	18.5	09.9	81	71.4	38.2	141	124.4	66.5	201	177.3	94.8	261	230.2	123.0
22	19.4	10.4	82	72.3	38.7	42	125.2	66.9	02	178.1	95.2	62	231.1	123.5
23	20.3	10.8	83	73.2	39.1	43	126.1	67.4	03	179.0	95.7	63	231.9	124.0
24	21.2	11.3	84	74.1	39.6	44	127.0	67.9	04	179.9	96.2	64	232.8	124.4
25	22.0	11.8	85	75.0	40.1	45	127.9	68.4	05	180.8	96.6	65	233.7	124.9
26	22.9	12.3	86	75.8	40.5	46	128.8	68.8	06	181.7	97.1	66	234.6	125.4
27	23.8	12.7	87	76.7	41.0	47	129.6	69.3	07	182.6	97.6	67	235.5	125.9
28	24.7	13.2	88	77.6	41.5	48	130.5	69.8	08	183.4	98.0	68	236.4	126.3
29	25.6	13.7	89	78.5	42.0	49	131.4	70.2	09	184.3	98.5	69	237.2	126.8
30	26.5	14.1	90	79.4	42.4	50	132.3	70.7	10	185.2	99.0	70	238.1	127.3
31	27.3	14.6	91	80.3	42.9	151	133.2	71.2	211	186.1	99.5	271	239.0	127.7
32	28.2	15.1	92	81.1	43.4	52	134.1	71.7	12	187.0	99.9	72	239.9	128.2
33	29.1	15.5	93	82.0	43.8	53	134.9	72.1	13	187.8	100.4	73	240.8	128.7
34	30.0	16.0	94	82.9	44.3	54	135.8	72.6	14	188.7	100.9	74	241.6	129.2
35	30.9	16.5	95	83.8	44.8	55	136.7	73.1	15	189.6	101.4	75	242.5	129.6
36	31.7	17.0	96	84.7	45.3	56	137.6	73.5	16	190.5	101.8	76	243.4	130.1
37	32.6	17.4	97	85.5	45.7	57	138.5	74.0	17	191.4	102.3	77	244.3	130.6
38	33.5	17.9	98	86.4	46.2	58	139.3	74.5	18	192.3	102.8	78	245.2	131.0
39	34.4	18.4	99	87.3	46.7	59	140.2	75.0	19	193.1	103.2	79	246.1	131.5
40	35.3	18.9	100	88.2	47.1	60	141.1	75.4	20	194.0	103.7	80	246.9	132.0
41	36.2	19.3	101	89.1	47.6	161	142.0	75.9	221	194.9	104.2	281	247.8	132.5
42	37.0	19.8	02	90.0	48.1	62	142.9	76.4	22	195.8	104.7	82	248.7	132.9
43	37.9	20.3	03	90.8	48.6	63	143.8	76.8	23	196.7	105.1	83	249.6	133.4
44	38.8	20.7	04	91.7	49.0	64	144.6	77.3	24	197.6	105.6	84	250.5	133.9
45	39.7	21.2	05	92.6	49.5	65	145.5	77.8	25	198.4	106.1	85	251.4	134.3
46	40.6	21.7	06	93.5	50.0	66	146.4	78.3	26	199.3	106.5	86	252.2	134.8
47	41.5	22.1	07	94.4	50.4	67	147.3	78.7	27	200.2	107.0	87	253.1	135.3
48	42.3	22.6	08	95.2	50.9	68	148.2	79.2	28	201.1	107.5	88	254.0	135.8
49	43.2	23.1	09	96.1	51.4	69	149.0	79.7	29	202.0	107.9	89	254.9	136.2
50	44.1	23.6	10	97.0	51.9	70	149.9	80.1	30	202.8	108.4	90	255.8	136.7
51	45.0	24.0	111	97.9	52.3	171	150.8	80.6	231	203.7	108.9	291	256.6	137.2
52	45.9	24.5	12	98.8	32.8	72	151.7	81.1	32	204.6	109.4	92	257.5	137.6
53	46.7	25.0	13	99.7	53.3	73	152.6	81.6	33	205.5	109.8	93	258.4	138.1
54	47.6	25.5	14	100.5	53.7	74	153.5	82.0	34	206.4	110.3	94	259.3	138.6
55	48.5	25.9	15	101.4	54.2	75	154.3	82.5	35	207.3	110.8	95	260.2	139.1
56	49.4	26.4	16	102.3	54.7	76	155.2	83.0	36	208.1	111.2	96	261.0	139.5
57	50.3	26.9	17	103.2	55.2	77	156.1	83.4	37	209.0	111.7	97	261.9	140.0
58	51.2	27.3	18	104.1	55.6	78	157.0	83.9	38	209.9	112.2	98	262.8	140.5
59	52.0	27.8	19	104.9	56.1	79	157.9	84.4	39	210.8	112.7	99	263.7	140.9
60	52.9	28.3	20	105.8	56.6	80	158.8	84.9	40	211.7	113.1	300	264.6	141.4
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 5 ½ Points.

TABLE I. Difference of Latitude and Departure for 1 ¾ Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.2	61	59.2	14.8	121	117.4	29.4	181	175.6	44.0	241	233.8	58.6
2	01.9	00.5	62	60.1	15.1	22	118.3	29.6	82	176.5	44.2	42	234.7	58.8
3	02.9	00.7	63	61.1	15.3	23	119.3	29.9	83	177.5	44.5	43	235.7	59.0
4	03.9	01.0	64	62.1	15.6	24	120.3	30.1	84	178.5	44.7	44	236.7	59.3
5	04.9	01.2	65	63.1	15.8	25	121.3	30.4	85	179.5	45.0	45	237.7	59.5
6	05.8	01.5	66	64.0	16.0	26	122.2	30.6	86	180.4	45.2	46	238.6	59.8
7	06.8	01.7	67	65.0	16.3	27	123.2	30.9	87	181.4	45.4	47	239.6	60.0
8	07.8	01.9	68	66.0	16.5	28	124.2	31.1	88	182.4	45.7	48	240.6	60.3
9	08.7	02.2	69	66.9	16.8	29	125.1	31.3	89	183.3	45.9	49	241.5	60.5
10	09.7	02.4	70	67.9	17.0	30	126.1	31.6	90	184.3	46.2	50	242.5	60.7
11	10.7	02.7	71	68.9	17.3	131	127.1	31.8	191	185.3	46.4	251	243.5	61.0
12	11.6	02.9	72	69.8	17.5	32	128.0	32.1	92	186.2	46.7	52	244.4	61.2
13	12.6	03.2	73	70.8	17.7	33	129.0	32.3	93	187.2	46.9	53	245.4	61.5
14	13.6	03.4	74	71.8	18.0	34	130.0	32.6	94	188.2	47.1	54	246.4	61.7
15	14.6	03.6	75	72.8	18.2	35	131.0	32.8	95	189.2	47.4	55	247.4	62.0
16	15.5	03.9	76	73.7	18.5	36	131.9	33.0	96	190.1	47.6	56	248.3	62.2
17	16.5	04.1	77	74.7	18.7	37	132.9	33.3	97	191.1	47.9	57	249.3	62.4
18	17.5	04.4	78	75.7	19.0	38	133.9	33.5	98	192.1	48.1	58	250.3	62.7
19	18.4	04.6	79	76.6	19.2	39	134.8	33.8	99	193.0	48.4	59	251.2	62.9
20	19.4	04.9	80	77.6	19.4	40	135.8	34.0	200	194.0	48.6	60	252.2	63.2
21	20.4	05.1	81	78.6	19.7	141	136.8	34.3	201	195.0	48.8	261	253.2	63.4
22	21.3	05.3	82	79.5	19.9	42	137.7	34.5	02	195.9	49.1	62	254.1	63.7
23	22.3	05.6	83	80.5	20.2	43	138.7	34.7	03	196.9	49.3	63	255.1	63.9
24	23.3	05.8	84	81.5	20.4	44	139.7	35.0	04	197.9	49.6	64	256.1	64.1
25	24.3	06.1	85	82.5	20.7	45	140.7	35.2	05	198.9	49.8	65	257.1	64.4
26	25.2	06.3	86	83.4	20.9	46	141.6	35.5	06	199.8	50.1	66	258.0	64.6
27	26.2	06.6	87	84.4	21.1	47	142.6	35.7	07	200.8	50.3	67	259.0	64.9
28	27.2	06.8	88	85.4	21.4	48	143.6	36.0	08	201.8	50.5	68	260.0	65.1
29	28.1	07.0	89	86.3	21.6	49	144.5	36.2	09	202.7	50.8	69	260.9	65.4
30	29.1	07.3	90	87.3	21.9	50	145.5	36.4	10	203.7	51.0	70	261.9	65.6
31	30.1	07.5	91	88.3	22.1	151	146.5	36.7	211	204.7	51.3	271	262.9	65.8
32	31.0	07.8	92	89.2	22.4	52	147.4	36.9	12	205.6	51.5	72	263.8	66.1
33	32.0	08.0	93	90.2	22.6	53	148.4	37.2	13	206.6	51.8	73	264.8	66.3
34	33.0	08.3	94	91.2	22.8	54	149.4	37.4	14	207.6	52.0	74	265.8	66.6
35	34.0	08.5	95	92.2	23.1	55	150.4	37.7	15	208.6	52.2	75	266.8	66.8
36	34.9	08.7	96	93.1	23.3	56	151.3	37.9	16	209.5	52.5	76	267.7	67.1
37	35.9	09.0	97	94.1	23.6	57	152.3	38.1	17	210.5	52.7	77	268.7	67.3
38	36.9	09.2	98	95.1	23.8	58	153.3	38.4	18	211.5	53.0	78	269.7	67.5
39	37.8	09.5	99	96.0	24.1	59	154.2	38.6	19	212.4	53.2	79	270.6	67.8
40	38.8	09.7	100	97.0	24.3	60	155.2	38.9	20	213.4	53.5	80	271.6	68.0
41	39.8	10.0	101	98.0	24.5	161	156.2	39.1	221	214.4	53.7	281	272.6	68.3
42	40.7	10.2	02	98.9	24.8	62	157.1	39.4	22	215.3	53.9	82	273.5	68.5
43	41.7	10.4	03	99.9	25.0	63	158.1	39.6	23	216.3	54.2	83	274.5	68.8
44	42.7	10.7	04	100.9	25.3	64	159.1	39.8	24	217.3	54.4	84	275.5	69.0
45	43.7	10.9	05	101.9	25.5	65	160.1	40.1	25	218.3	54.7	85	276.5	69.2
46	44.6	11.2	06	102.8	25.8	66	161.0	40.3	26	219.2	54.9	86	277.4	69.5
47	45.6	11.4	07	103.8	26.0	67	162.0	40.6	27	220.2	55.2	87	278.4	69.7
48	46.6	11.7	08	104.8	26.2	68	163.0	40.8	28	221.2	55.4	88	279.4	70.0
49	47.5	11.9	09	105.7	26.5	69	163.9	41.1	29	222.1	55.6	89	280.3	70.2
50	48.5	12.1	10	106.7	26.7	70	164.9	41.3	30	223.1	55.9	90	281.3	70.5
51	49.5	12.4	111	107.7	27.0	171	165.9	41.5	231	224.1	56.1	291	282.3	70.7
52	50.4	12.6	12	108.6	27.2	72	166.8	41.8	32	225.0	56.4	92	283.2	71.0
53	51.4	12.9	13	109.6	27.5	73	167.8	42.0	33	226.0	56.6	93	284.2	71.2
54	52.4	13.1	14	110.6	27.7	74	168.8	42.3	34	227.0	56.9	94	285.2	71.4
55	53.4	13.4	15	111.6	27.9	75	169.8	42.5	35	228.0	57.1	95	286.2	71.7
56	54.3	13.6	16	112.5	28.2	76	170.7	42.8	36	228.9	57.3	96	287.1	71.9
57	55.3	13.8	17	113.5	28.4	77	171.7	43.0	37	229.9	57.6	97	288.1	72.2
58	56.3	14.1	18	114.5	28.7	78	172.7	43.3	38	230.9	57.8	98	289.1	72.4
59	57.2	14.3	19	115.4	28.9	79	173.6	43.5	39	231.8	58.1	99	290.0	72.7
60	58.2	14.6	20	116.4	29.2	80	174.6	43.7	40	232.8	58.3	300	291.0	72.9
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 6 ¼ Points.

TABLE I. Difference of Latitude and Departure for 3 Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	50.7	33.9	121	100.6	67.2	181	150.5	100.5	241	200.4	133.9
2	01.7	01.1	62	51.6	34.4	22	101.4	67.8	82	151.3	101.1	42	201.2	134.4
3	02.5	01.7	63	52.4	35.0	23	102.3	68.3	83	152.1	101.7	43	202.0	135.0
4	03.3	02.2	64	53.2	35.6	24	103.1	68.9	84	153.0	102.2	44	202.9	135.5
5	04.2	02.8	65	54.0	36.1	25	103.9	69.4	85	153.8	102.8	45	203.7	136.1
6	05.0	03.3	66	54.9	36.7	26	104.8	70.0	86	154.7	103.3	46	204.5	136.7
7	05.8	03.9	67	55.7	37.2	27	105.6	70.5	87	155.5	103.9	47	205.3	137.2
8	06.7	04.4	68	56.5	37.8	28	106.4	71.1	88	156.3	104.4	48	206.2	137.8
9	07.5	05.0	69	57.4	38.3	29	107.3	71.7	89	157.1	105.0	49	207.0	138.3
10	08.3	05.6	70	58.2	38.9	30	108.1	72.2	90	158.0	105.5	50	207.9	138.9
11	09.1	06.1	71	59.0	39.4	131	108.9	72.8	191	158.8	106.1	251	208.7	139.4
12	10.0	06.7	72	59.9	40.0	32	109.8	73.3	92	159.6	106.7	52	209.5	140.0
13	10.8	07.2	73	60.7	40.6	33	110.6	73.9	93	160.5	107.2	53	210.4	140.5
14	11.6	07.8	74	61.5	41.1	34	111.4	74.4	94	161.3	107.8	54	211.2	141.1
15	12.5	08.3	75	62.4	41.7	35	112.2	75.0	95	162.1	108.3	55	212.0	141.7
16	13.3	08.9	76	63.2	42.2	36	113.1	75.5	96	163.0	108.9	56	212.9	142.2
17	14.1	09.4	77	64.0	42.8	37	113.9	76.1	97	163.8	109.4	57	213.7	142.8
18	15.0	10.0	78	64.9	43.3	38	114.7	76.7	98	164.6	110.0	58	214.5	143.3
19	15.8	10.6	79	65.7	43.9	39	115.6	77.2	99	165.5	110.5	59	215.4	143.9
20	16.6	11.1	80	66.5	44.4	40	116.4	77.8	200	166.3	111.1	60	216.2	144.4
21	17.5	11.7	81	67.3	45.0	141	117.2	78.3	201	167.1	111.7	261	217.0	145.0
22	18.3	12.2	82	68.2	45.6	42	118.1	78.9	02	168.0	112.2	62	217.8	145.5
23	19.1	12.8	83	69.0	46.1	43	118.9	79.4	03	168.8	112.8	63	218.7	146.1
24	20.0	13.3	84	69.8	46.7	44	119.7	80.0	04	169.6	113.3	64	219.5	146.7
25	20.8	13.9	85	70.7	47.2	45	120.6	80.5	05	170.5	113.9	65	220.3	147.2
26	21.6	14.4	86	71.5	47.8	46	121.4	81.1	06	171.3	114.4	66	221.2	147.8
27	22.4	15.0	87	72.3	48.3	47	122.2	81.7	07	172.1	115.0	67	222.0	148.3
28	23.3	15.6	88	73.2	48.9	48	123.1	82.2	08	172.9	115.5	68	222.8	148.9
29	24.1	16.1	89	74.0	49.4	49	123.9	82.8	09	173.8	116.1	69	223.7	149.4
30	24.9	16.7	90	74.8	50.0	50	124.7	83.3	10	174.6	116.7	70	224.5	150.0
31	25.8	17.2	91	75.7	50.6	151	125.6	83.9	211	175.4	117.2	271	225.3	150.5
32	26.6	17.8	92	76.5	51.1	52	126.4	84.4	12	176.3	117.8	72	226.2	151.1
33	27.4	18.3	93	77.3	51.7	53	127.2	85.0	13	177.1	118.3	73	227.0	151.7
34	28.2	18.9	94	78.2	52.2	54	128.0	85.5	14	177.9	118.9	74	227.8	152.2
35	29.1	19.4	95	79.0	52.8	55	128.9	86.1	15	178.8	119.4	75	228.7	152.8
36	29.9	20.0	96	79.8	53.3	56	129.7	86.7	16	179.6	120.0	76	229.5	153.3
37	30.8	20.6	97	80.7	53.9	57	130.5	87.2	17	180.4	120.5	77	230.3	153.9
38	31.6	21.1	98	81.5	54.4	58	131.4	87.8	18	181.3	121.1	78	231.1	154.4
39	32.4	21.7	99	82.3	55.0	59	132.2	88.3	19	182.1	121.7	79	232.0	155.0
40	33.3	22.2	100	83.1	55.6	60	133.0	88.9	20	182.9	122.2	80	232.8	155.5
41	34.1	22.8	101	84.0	56.1	161	133.9	89.4	221	183.8	122.8	281	233.6	156.1
42	34.9	23.3	02	84.8	56.7	62	134.7	90.0	22	184.6	123.3	82	234.5	156.7
43	35.8	23.9	03	85.6	57.2	63	135.5	90.5	23	185.4	123.9	83	235.3	157.2
44	36.6	24.4	04	86.5	57.8	64	136.4	91.1	24	186.2	124.4	84	236.1	157.8
45	37.4	25.0	05	87.3	58.3	65	137.2	91.7	25	187.1	125.0	85	237.0	158.3
46	38.2	25.6	06	88.1	58.9	66	138.0	92.2	26	187.9	125.5	86	237.8	158.9
47	39.1	26.1	07	89.0	59.4	67	138.9	92.8	27	188.7	126.1	87	238.6	159.4
48	39.9	26.7	08	89.8	60.0	68	139.7	93.3	28	189.6	126.7	88	239.5	160.0
49	40.7	27.2	09	90.6	60.6	69	140.5	93.9	29	190.4	127.2	89	240.3	160.5
50	41.6	27.8	10	91.5	61.1	70	141.3	94.4	30	191.2	127.8	90	241.1	161.1
51	42.4	28.3	111	92.3	61.7	171	142.2	95.0	231	192.1	128.3	291	242.0	161.7
52	43.2	28.9	12	93.1	62.2	72	143.0	95.5	32	192.9	128.9	92	242.8	162.2
53	44.1	29.4	13	94.0	62.8	73	143.8	96.1	33	193.7	129.4	93	243.6	162.8
54	44.9	30.0	14	94.8	63.3	74	144.7	96.7	34	194.6	130.0	94	244.5	163.3
55	45.7	30.6	15	95.6	63.9	75	145.5	97.2	35	195.4	130.5	95	245.3	163.9
56	46.6	31.1	16	96.5	64.4	76	146.3	97.8	36	196.2	131.1	96	246.1	164.4
57	47.4	31.7	17	97.3	65.0	77	147.2	98.3	37	197.1	131.7	97	246.9	165.0
58	48.2	32.2	18	98.1	65.5	78	148.0	98.9	38	197.9	132.2	98	247.8	165.5
59	49.1	32.8	19	98.9	66.1	79	148.8	99.4	39	198.7	132.8	99	248.6	166.1
60	49.9	33.3	20	99.8	66.7	80	149.7	100.0	40	199.6	133.3	300	249.4	166.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 5 Points.

TABLE I. Difference of Latitude and Departure for 1 ¾ Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.3	61	57.4	20.5	121	113.9	40.8	181	170.4	61.0	241	226.9	81.2
2	01.9	00.7	62	58.4	20.9	22	114.9	41.1	82	171.4	61.3	42	227.9	81.5
3	02.8	01.0	63	59.3	21.2	23	115.8	41.4	83	172.3	61.7	43	228.8	81.9
4	03.8	01.3	64	60.3	21.6	24	116.8	41.8	84	173.2	62.0	44	229.7	82.2
5	04.7	01.7	65	61.2	21.9	25	117.7	42.1	85	174.2	62.3	45	230.7	82.5
6	05.6	02.0	66	62.1	22.2	26	118.6	42.4	86	175.1	62.7	46	231.6	82.9
7	06.6	02.4	67	63.1	22.6	27	119.6	42.8	87	176.1	63.0	47	232.6	83.2
8	07.5	02.7	68	64.0	22.9	28	120.5	43.1	88	177.0	63.3	48	233.5	83.5
9	08.5	03.0	69	65.0	23.2	29	121.5	43.5	89	177.9	63.7	49	234.4	83.9
10	09.4	03.4	70	65.9	23.6	30	122.4	43.8	90	178.9	64.0	50	235.4	84.2
11	10.4	03.7	71	66.8	23.9	131	123.3	44.1	191	179.8	64.3	251	236.3	84.6
12	11.3	04.0	72	67.8	24.3	32	124.3	44.5	92	180.8	64.7	52	237.3	84.9
13	12.2	04.4	73	68.7	24.6	33	125.2	44.8	93	181.7	65.0	53	238.2	85.2
14	13.2	04.7	74	69.7	24.9	34	126.2	45.1	94	182.7	65.4	54	239.2	85.6
15	14.1	05.1	75	70.6	25.3	35	127.1	45.5	95	183.6	65.7	55	240.1	85.9
16	15.1	05.4	76	71.6	25.6	36	128.0	45.8	96	184.5	66.0	56	241.0	86.2
17	16.0	05.7	77	72.5	25.9	37	129.0	46.2	97	185.5	66.4	57	242.0	86.6
18	17.0	06.1	78	73.4	26.3	38	129.9	46.5	98	186.4	66.7	58	242.9	86.9
19	17.9	06.4	79	74.4	26.6	39	130.9	46.8	99	187.4	67.0	59	243.9	87.2
20	18.8	06.7	80	75.3	27.0	40	131.8	47.2	200	188.3	67.4	60	244.8	87.6
21	19.8	07.1	81	76.3	27.3	141	132.8	47.5	201	189.3	67.7	261	245.7	87.9
22	20.7	07.4	82	77.2	27.6	42	133.7	47.8	02	190.2	68.1	62	246.7	88.3
23	21.7	07.7	83	78.1	28.0	43	134.6	48.2	03	191.1	68.4	63	247.6	88.6
24	22.6	08.1	84	79.1	28.3	44	135.6	48.5	04	192.1	68.7	64	248.6	88.9
25	23.5	08.4	85	80.0	28.6	45	136.5	48.8	05	193.0	69.1	65	249.5	89.3
26	24.5	08.8	86	81.0	29.0	46	137.5	49.2	06	194.0	69.4	66	250.5	89.6
27	25.4	09.1	87	81.9	29.3	47	138.4	49.5	07	194.9	69.7	67	251.4	89.9
28	26.4	09.4	88	82.9	29.6	48	139.3	49.9	08	195.8	70.1	68	252.3	90.3
29	27.3	09.8	89	83.8	30.0	49	140.3	50.2	09	196.8	70.4	69	253.3	90.6
30	28.2	10.1	90	84.7	30.3	50	141.2	50.5	10	197.7	70.7	70	254.2	90.9
31	29.2	10.4	91	85.7	30.7	151	142.2	50.9	211	198.7	71.1	271	255.2	91.3
32	30.1	10.8	92	86.6	31.0	52	143.1	51.2	12	199.6	71.5	72	256.1	91.6
33	31.1	11.1	93	87.6	31.3	53	144.1	51.5	13	200.5	71.7	73	257.0	92.0
34	32.0	11.5	94	88.5	31.7	54	145.0	51.9	14	201.5	72.1	74	258.0	92.3
35	33.0	11.8	95	89.4	32.0	55	145.9	52.2	15	202.4	72.4	75	258.9	92.6
36	33.9	12.1	96	90.4	32.3	56	146.9	52.6	16	203.4	72.8	76	259.9	93.0
37	34.8	12.5	97	91.3	32.7	57	147.8	52.9	17	204.3	73.1	77	260.8	93.3
38	35.8	12.8	98	92.3	33.0	58	148.8	53.2	18	205.2	73.4	78	261.7	93.7
39	36.7	13.1	99	93.2	33.4	59	149.7	53.6	19	206.2	73.8	79	262.7	94.0
40	37.7	13.5	100	94.2	33.7	60	150.6	53.9	20	207.1	74.1	80	263.6	94.3
41	38.6	13.8	101	95.1	34.0	161	151.6	54.2	221	208.1	74.5	281	264.6	94.7
42	39.5	14.1	02	96.0	34.4	62	152.5	54.6	22	209.0	74.8	82	265.5	95.0
43	40.5	14.5	03	97.0	34.7	63	153.5	54.9	23	210.0	75.1	83	266.5	95.3
44	41.4	14.8	04	97.9	35.0	64	154.4	55.2	24	210.9	75.5	84	267.4	95.7
45	42.4	15.2	05	98.9	35.4	65	155.4	55.6	25	211.8	75.8	85	268.3	96.0
46	43.3	15.5	06	99.8	35.7	66	156.3	55.9	26	212.8	76.1	86	269.3	96.4
47	44.3	15.8	07	100.7	36.0	67	157.2	56.2	27	213.7	76.5	87	270.2	96.7
48	45.2	16.2	08	101.7	36.4	68	158.2	56.6	28	214.7	76.8	88	271.2	97.0
49	46.1	16.5	09	102.6	36.7	69	159.1	56.9	29	215.6	77.1	89	272.1	97.4
50	47.1	16.8	10	103.6	37.1	70	160.1	57.3	30	216.6	77.5	90	273.0	97.7
51	48.0	17.2	111	104.5	37.4	171	161.0	57.6	231	217.5	77.8	291	274.0	98.0
52	49.0	17.5	12	105.5	37.7	72	161.9	57.9	32	218.4	78.2	92	274.9	98.4
53	49.9	17.9	13	106.4	38.1	73	162.9	58.3	33	219.4	78.5	93	275.9	98.7
54	50.8	18.2	14	107.3	38.4	74	163.8	58.6	34	220.3	78.8	94	276.8	99.0
55	51.8	18.5	15	108.3	38.7	75	164.8	59.0	35	221.3	79.2	95	277.8	99.4
56	52.7	18.9	16	109.2	39.1	76	165.7	59.3	36	222.2	79.5	96	278.7	99.7
57	53.7	19.2	17	110.2	39.4	77	166.7	59.6	37	223.1	79.8	97	279.6	100.1
58	54.6	19.5	18	111.1	39.8	78	167.6	60.0	38	224.1	80.2	98	280.6	100.4
59	55.5	19.9	19	112.0	40.1	79	168.5	60.3	39	225.0	80.5	99	281.5	100.7
60	56.5	20.2	20	113.0	40.4	80	169.5	60.6	40	226.0	80.8	300	282.5	101.1
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 6 ¼ Points.

TABLE I. Difference of Latitude and Departure for 3 ½ Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	47.1	38.7	121	93.5	76.8	181	139.9	114.8	241	186.3	152.9
2	01.5	01.3	62	47.9	39.3	22	94.3	77.4	82	140.7	115.5	42	187.1	153.5
3	02.3	01.9	63	48.7	40.0	23	95.1	78.0	83	141.5	116.1	43	187.8	154.2
4	03.1	02.5	64	49.5	40.6	24	95.9	78.7	84	142.2	116.7	44	188.6	154.8
5	03.9	03.2	65	50.2	41.2	25	96.6	79.3	85	143.0	117.4	45	189.4	155.4
6	04.6	03.8	66	51.0	41.9	26	97.4	79.9	86	143.8	118.0	46	190.2	156.1
7	05.4	04.4	67	51.8	42.5	27	98.2	80.6	87	144.6	118.6	47	190.9	156.7
8	06.2	05.1	68	52.6	43.1	28	98.9	81.2	88	145.3	119.3	48	191.7	157.3
9	07.0	05.7	69	53.3	43.8	29	99.7	81.8	89	146.1	119.9	49	192.5	158.0
10	07.7	06.3	70	54.1	44.4	30	100.5	82.5	90	146.9	120.5	50	193.3	158.6
11	08.5	07.0	71	54.9	45.0	131	101.2	83.1	191	147.6	121.2	251	194.0	159.2
12	09.3	07.6	72	55.7	45.7	32	102.0	83.7	92	148.4	121.8	52	194.8	159.9
13	10.0	08.2	73	56.4	46.3	33	102.8	84.4	93	149.2	122.4	53	195.6	160.5
14	10.8	08.9	74	57.2	46.9	34	103.6	85.0	94	150.0	123.1	54	196.3	161.1
15	11.6	09.5	75	58.0	47.6	35	104.4	85.6	95	150.7	123.7	55	197.1	161.8
16	12.4	10.1	76	58.7	48.2	36	105.1	86.3	96	151.5	124.3	56	197.9	162.4
17	13.1	10.8	77	59.5	48.8	37	105.9	86.9	97	152.3	125.0	57	198.7	163.0
18	13.9	11.4	78	60.3	49.5	38	106.7	87.5	98	153.1	125.6	58	199.4	163.7
19	14.7	12.1	79	61.1	50.1	39	107.4	88.2	99	153.8	126.2	59	200.2	164.3
20	15.5	12.7	80	61.8	50.8	40	108.2	88.8	200	154.6	126.9	60	201.0	164.9
21	16.2	13.3	81	62.6	51.4	141	109.0	89.4	201	155.4	127.5	261	201.8	165.6
22	17.0	14.0	82	63.4	52.0	42	109.8	90.1	02	156.1	128.1	62	202.5	166.2
23	17.8	14.6	83	64.2	52.6	43	110.5	90.7	03	156.9	128.8	63	203.3	166.8
24	18.6	15.2	84	64.9	53.3	44	111.3	91.4	04	157.7	129.4	64	204.1	167.5
25	19.3	15.9	85	65.7	53.9	45	112.1	92.0	05	158.5	130.1	65	204.8	168.1
26	20.1	16.5	86	66.5	54.6	46	112.9	92.6	06	159.2	130.7	66	205.6	168.7
27	20.9	17.1	87	67.3	55.2	47	113.6	93.3	07	160.0	131.3	67	206.4	169.4
28	21.6	17.8	88	68.0	55.8	48	114.4	93.9	08	160.8	132.0	68	207.2	170.0
29	22.4	18.4	89	68.8	56.5	49	115.2	94.5	09	161.6	132.6	69	207.9	170.7
30	23.2	19.0	90	69.6	57.1	50	116.0	95.2	10	162.3	133.2	70	208.7	171.3
31	24.0	19.7	91	70.3	57.7	151	116.7	95.8	211	163.1	133.9	271	209.5	171.9
32	24.7	20.3	92	71.1	58.4	52	117.5	96.4	12	163.9	134.5	72	210.3	172.6
33	25.5	20.9	93	71.9	59.0	53	118.3	97.1	13	164.7	135.1	73	211.0	173.2
34	26.3	21.6	94	72.7	59.6	54	119.0	97.7	14	165.4	135.8	74	211.8	173.8
35	27.1	22.2	95	73.4	60.3	55	119.8	98.3	15	166.2	136.4	75	212.6	174.5
36	27.8	22.8	96	74.2	60.9	56	120.6	99.0	16	167.0	137.0	76	213.4	175.1
37	28.6	23.5	97	75.0	61.5	57	121.4	99.6	17	167.7	137.7	77	214.1	175.7
38	29.4	24.1	98	75.8	62.1	58	122.1	100.2	18	168.5	138.3	78	214.9	176.4
39	30.1	24.7	99	76.5	62.8	59	122.9	100.9	19	169.3	138.9	79	215.7	177.0
40	30.9	25.4	100	77.3	63.4	60	123.7	101.5	20	170.1	139.6	80	216.4	177.6
41	31.7	26.0	101	78.1	64.1	161	124.3	102.1	221	170.8	140.2	281	217.2	178.3
42	32.5	26.6	02	78.8	64.7	62	125.2	102.8	22	171.6	140.8	82	218.0	178.9
43	33.2	27.3	03	79.6	65.3	63	126.0	103.4	23	172.4	141.5	83	218.8	179.6
44	34.0	27.9	04	80.4	66.0	64	126.8	104.0	24	173.2	142.1	84	219.5	180.2
45	34.8	28.5	05	81.2	66.6	65	127.5	104.7	25	173.9	142.7	85	220.3	180.8
46	35.6	29.2	06	81.9	67.2	66	128.3	105.3	26	174.7	143.4	86	221.1	181.4
47	36.3	29.8	07	82.7	67.9	67	129.1	105.9	27	175.5	144.0	87	221.9	182.1
48	37.1	30.5	08	83.5	68.5	68	129.9	106.6	28	176.2	144.6	88	222.6	182.7
49	37.9	31.1	09	84.3	69.1	69	130.6	107.2	29	177.0	145.3	89	223.4	183.3
50	38.7	31.7	10	85.0	69.8	70	131.4	107.8	30	177.8	145.9	90	224.2	184.0
51	39.4	32.4	111	85.8	70.4	171	132.2	108.5	231	178.6	146.5	291	224.9	184.6
52	40.2	33.0	12	86.6	71.1	72	133.0	109.1	32	179.3	147.2	92	225.7	185.2
53	41.0	33.6	13	87.4	71.7	73	133.7	109.7	33	180.1	147.8	93	226.5	185.9
54	41.7	34.3	14	88.1	72.3	74	134.5	110.4	34	180.9	148.4	94	227.3	186.5
55	42.5	34.9	15	88.9	73.0	75	135.3	111.0	35	181.7	149.1	95	228.0	187.1
56	43.3	35.5	16	89.7	73.6	76	136.0	111.7	36	182.4	149.7	96	228.8	187.8
57	44.1	36.2	17	90.4	74.2	77	136.8	112.3	37	183.2	150.3	97	229.6	188.4
58	44.8	36.8	18	91.2	74.9	78	137.6	112.9	38	184.0	151.0	98	230.4	189.0
59	45.6	37.4	19	92.0	75.5	79	138.4	113.6	39	184.7	151.6	99	231.1	189.6
60	46.4	38.1	20	92.8	76.1	80	139.1	114.2	40	185.5	152.3	300	231.9	190.3
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 4 ½ Points.

TABLE I. Difference of Latitude and Departure for 2 ¾ Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.4	61	55.1	26.1	121	109.4	51.7	181	163.6	77.4	241	217.9	103.0
2	01.8	00.9	62	56.0	26.5	22	110.3	52.2	82	164.5	77.8	42	218.8	103.5
3	02.7	01.3	63	57.0	26.9	23	111.2	52.6	83	165.4	78.2	43	219.7	103.9
4	03.6	01.7	64	57.9	27.4	24	112.1	53.0	84	166.3	78.7	44	220.6	104.3
5	04.5	02.1	65	58.8	27.8	25	113.0	53.4	85	167.2	79.1	45	221.5	104.8
6	05.4	02.6	66	59.7	28.2	26	113.9	53.9	86	168.1	79.5	46	222.4	105.2
7	06.3	03.0	67	60.6	28.6	27	114.8	54.3	87	169.0	80.0	47	223.3	105.6
8	07.2	03.4	68	61.5	29.1	28	115.7	54.7	88	169.9	80.4	48	224.2	106.0
9	08.1	03.8	69	62.4	29.5	29	116.6	55.2	89	170.8	80.8	49	225.1	106.5
10	09.0	04.3	70	63.3	29.9	30	117.5	55.6	90	171.8	81.2	50	226.0	106.9
11	09.9	04.7	71	64.2	30.4	131	118.4	56.0	191	172.7	81.7	251	226.9	107.3
12	10.8	05.1	72	65.1	30.8	32	119.3	56.4	92	173.6	82.1	52	227.8	107.7
13	11.8	05.6	73	66.0	31.2	33	120.2	56.9	93	174.5	82.5	53	228.7	108.2
14	12.7	06.0	74	66.9	31.6	34	121.1	57.3	94	175.4	82.9	54	229.6	108.6
15	13.6	06.4	75	67.8	32.1	35	122.0	57.7	95	176.3	83.4	55	230.5	109.0
16	14.5	06.8	76	68.7	32.5	36	122.9	58.1	96	177.2	83.8	56	231.4	109.5
17	15.4	07.3	77	69.6	32.9	37	123.8	58.6	97	178.1	84.2	57	232.3	109.9
18	16.3	07.7	78	70.5	33.3	38	124.8	59.0	98	179.0	84.7	58	233.2	110.3
19	17.2	08.1	79	71.4	33.8	39	125.7	59.4	99	179.9	85.1	59	234.1	110.7
20	18.1	08.6	80	72.3	34.2	40	126.6	59.9	200	180.8	85.5	60	235.0	111.2
21	19.0	09.0	81	73.2	34.6	141	127.5	60.3	201	181.7	85.9	261	235.9	111.6
22	19.9	09.4	82	74.1	35.1	42	128.4	60.7	02	182.6	86.4	62	236.8	112.0
23	20.8	09.8	83	75.0	35.5	43	129.3	61.1	03	183.5	86.8	63	237.7	112.4
24	21.7	10.3	84	75.9	35.9	44	130.2	61.6	04	184.4	87.2	64	238.7	112.9
25	22.6	10.7	85	76.8	36.3	45	131.1	62.0	05	185.3	87.6	65	239.6	113.3
26	23.5	11.1	86	77.7	36.8	46	132.0	62.4	06	186.2	88.1	66	240.5	113.7
27	24.4	11.5	87	78.[illegible]	[illegible]7.2	47	132.9	62.9	07	187.1	88.5	67	241.4	114.2
28	25.3	12.0	88	79.6	37.6	48	133.8	63.3	08	188.0	88.9	68	242.3	114.6
29	26.2	12.4	89	80.5	38.1	49	134.7	63.7	09	188.9	89.4	69	243.2	115.0
30	27.1	12.8	90	81.4	38.5	50	135.6	64.1	10	189.8	89.8	70	244.1	115.4
31	28.0	13.3	91	82.3	38.9	151	136.5	64.6	211	190.7	90.2	271	245.0	115.9
32	28.9	13.7	92	83.2	39.3	52	137.4	65.0	12	191.6	90.6	72	245.9	116.3
33	29.8	14.1	93	84.1	39.8	53	138.3	65.4	13	192.5	91.1	73	246.8	116.7
34	30.7	14.5	94	85.0	40.2	54	139.2	65.8	14	193.5	91.5	74	247.7	117.2
35	31.6	15.0	95	85.9	40.6	55	140.1	66.3	15	194.4	91.9	75	248.6	117.6
36	32.5	15.4	96	86.8	41.0	56	141.0	66.7	16	195.3	92.4	76	249.5	118.0
37	33.4	15.8	97	87.7	41.5	57	141.9	67.1	17	196.2	92.8	77	250.4	118.4
38	34.4	16.2	98	88.6	41.9	58	142.8	67.6	18	197.1	93.2	78	251.3	118.9
39	35.3	16.7	99	89.5	42.3	59	143.7	68.0	19	198.0	93.6	79	252.2	119.3
40	36.2	17.1	100	90.4	42.8	60	144.6	68.4	20	198.9	94.1	80	253.1	119.7
41	37.1	17.5	101	91.3	43.2	161	145.5	68.8	221	199.8	94.5	281	254.0	120.1
42	38.0	18.0	02	92.2	43.6	62	146.4	69.3	22	200.7	94.9	82	254.9	120.6
43	38.9	18.4	03	93.1	44.0	63	147.4	69.7	23	201.6	95.3	83	255.8	121.0
44	39.8	18.8	04	94.0	44.5	64	148.3	70.1	24	202.5	95.8	84	256.7	121.4
45	40.7	19.2	05	94.9	44.9	65	149.2	70.5	25	203.4	96.2	85	257.6	121.9
46	41.6	19.7	06	95.8	45.3	66	150.0	71.0	26	204.3	96.6	86	258.5	122.3
47	42.5	20.1	07	96.7	45.7	67	151.0	71.4	27	205.2	97.1	87	259.4	122.7
48	43.4	20.5	08	97.6	46.2	68	151.9	71.8	28	206.1	97.5	88	260.3	123.1
49	44.3	21.0	09	98.5	46.6	69	152.8	72.3	29	207.0	97.9	89	261.3	123.6
50	45.2	21.4	10	99.4	47.0	70	153.7	72.7	30	207.9	98.3	90	262.2	124.0
51	46.1	21.8	111	100.3	47.5	171	154.6	73.1	231	208.8	98.8	291	263.1	124.4
52	47.0	22.2	12	101.2	47.9	72	155.5	73.5	32	209.7	99.2	92	264.0	124.8
53	47.9	22.7	13	102.2	48.3	73	156.4	74.0	33	210.6	99.6	93	264.9	125.3
54	48.8	23.1	14	103.1	48.7	74	157.3	74.4	34	211.5	100.1	94	265.8	125.7
55	49.7	23.5	15	104.0	49.2	75	158.2	74.8	35	212.4	100.5	95	266.7	126.1
56	50.6	23.9	16	104.9	49.6	76	159.1	75.2	36	213.3	100.9	96	267.6	126.6
57	51.5	24.4	17	105.8	50.0	77	160.0	75.7	37	214.2	101.3	97	268.5	127.0
58	52.4	24.8	18	106.7	50.5	78	160.9	76.1	38	215.1	101.8	98	269.4	127.4
59	53.3	25.2	19	107.6	50.9	79	161.8	76.5	39	216.1	102.2	99	270.3	127.8
60	54.2	25.7	20	108.5	51.3	80	162.7	77.0	40	217.0	102.6	300	271.2	128.8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 5 ¼ Points.

TABLE I. Difference of Latitude and Departure for 4 Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.7	00.7	61	43.1	43.1	121	85.6	85.6	181	128.0	128.0	241	170.4	170.4
2	01.4	01.4	62	43.8	43.8	22	86.3	86.3	82	128.7	128.7	42	171.1	171.1
3	02.1	02.1	63	44.5	44.5	23	87.0	87.0	83	129.4	129.4	43	171.8	171.8
4	02.8	02.8	64	45.3	45.3	24	87.7	87.7	84	130.1	130.1	44	172.5	172.5
5	03.5	03.5	65	46.0	46.0	25	88.4	88.4	85	130.8	130.8	45	173.2	173.2
6	04.2	04.2	66	46.7	46.7	26	89.1	89.1	86	131.5	131.5	46	173.9	173.9
7	04.9	04.9	67	47.4	47.4	27	89.8	89.8	87	132.2	132.2	47	174.7	174.7
8	05.7	05.7	68	48.1	48.1	28	90.5	90.5	88	132.9	132.9	48	175.4	175.4
9	06.4	06.4	69	48.8	48.8	29	91.2	91.2	89	133.6	133.6	49	176.1	176.1
10	07.1	07.1	70	49.5	49.5	30	91.9	91.9	90	134.4	134.4	50	176.8	176.8
11	07.8	07.8	71	50.2	50.2	131	92.6	92.6	191	135.1	135.1	251	177.5	177.5
12	08.5	08.5	72	50.9	50.9	32	93.3	93.3	92	135.8	135.8	52	178.2	178.2
13	09.2	09.2	73	51.6	51.6	33	94.0	94.0	93	136.5	136.5	53	178.9	178.9
14	09.9	09.9	74	52.3	52.3	34	94.8	94.8	94	137.2	137.2	54	179.6	179.6
15	10.6	10.6	75	53.0	53.0	35	95.5	95.5	95	137.9	137.9	55	180.3	180.3
16	11.3	11.3	76	53.7	53.7	36	96.2	96.2	96	138.6	138.6	56	181.0	181.0
17	12.0	12.0	77	54.4	54.4	37	96.9	96.9	97	139.3	139.3	57	181.7	181.7
18	12.7	12.7	78	55.2	55.2	38	97.6	97.6	98	140.0	140.0	58	182.4	182.4
19	13.4	13.4	79	55.9	55.9	39	98.3	98.3	99	140.7	140.7	59	183.1	183.1
20	14.1	14.1	80	56.6	56.6	40	99.0	99.0	200	141.4	141.4	60	183.8	183.8
21	14.8	14.8	81	57.3	57.3	141	99.7	99.7	201	142.1	142.1	261	184.6	184.6
22	15.6	15.6	82	58.0	58.0	42	100.4	100.4	02	142.8	142.8	62	185.3	185.3
23	16.3	16.3	83	58.7	58.7	43	101.1	101.1	03	143.5	143.5	63	186.0	186.0
24	17.0	17.0	84	59.4	59.4	44	101.8	101.8	04	144.2	144.2	64	186.7	186.7
25	17.7	17.7	85	60.1	60.1	45	102.5	102.5	05	145.0	145.0	65	187.4	187.4
26	18.4	18.4	86	60.8	60.8	46	103.2	103.2	06	145.7	145.7	66	188.1	188.1
27	19.1	19.1	87	61.5	61.5	47	103.9	103.9	07	146.4	146.4	67	188.8	188.8
28	19.8	19.8	88	62.2	62.2	48	104.7	104.7	08	147.1	147.1	68	189.5	189.5
29	20.5	20.5	89	62.9	62.9	49	105.4	105.4	09	147.8	147.8	69	190.2	190.2
30	21.2	21.2	90	63.6	63.6	50	106.1	106.1	10	148.5	148.5	70	190.9	190.9
31	21.9	21.9	91	64.3	64.3	151	106.8	106.8	211	149.2	149.2	271	191.6	191.6
32	22.6	22.6	92	65.1	65.1	52	107.5	107.5	12	149.9	149.9	72	192.3	192.3
33	23.3	23.3	93	65.8	65.8	53	108.2	108.2	13	150.6	150.6	73	193.0	193.0
34	24.0	24.0	94	66.5	66.5	54	108.9	108.9	14	151.3	151.3	74	193.7	193.7
35	24.7	24.7	95	67.2	67.2	55	109.6	109.6	15	152.0	152.0	75	194.5	194.5
36	25.5	25.5	96	67.9	67.9	56	110.3	110.3	16	152.7	152.7	76	195.2	195.2
37	26.2	26.2	97	68.6	68.6	57	111.0	111.0	17	153.4	153.4	77	195.9	195.9
38	26.9	26.9	98	69.3	69.3	58	111.7	111.7	18	154.1	154.1	78	196.6	196.6
39	27.6	27.6	99	70.0	70.0	59	112.4	112.4	19	154.9	154.9	79	197.3	197.3
40	28.3	28.3	100	70.7	70.7	60	113.1	113.1	20	155.6	155.6	80	198.0	198.0
41	29.0	29.0	101	71.4	71.4	61	113.8	113.8	221	156.3	156.3	281	198.7	198.7
42	29.7	29.7	02	72.1	72.1	62	114.6	114.6	22	157.0	157.0	82	199.4	199.4
43	30.4	30.4	03	72.8	72.8	63	115.3	115.3	23	157.7	157.7	83	200.1	200.1
44	31.1	31.1	04	73.5	73.5	64	116.0	116.0	24	158.4	158.4	84	200.8	200.8
45	31.8	31.8	05	74.2	74.2	65	116.7	116.7	25	159.1	159.1	85	201.5	201.5
46	32.5	32.5	06	75.0	75.0	66	117.4	117.4	26	159.8	159.8	86	202.2	202.2
47	33.2	33.2	07	75.7	75.7	67	118.1	118.1	27	160.5	160.5	87	202.9	202.9
48	33.9	33.9	08	76.4	76.4	68	118.8	118.8	28	161.2	161.2	88	203.6	203.6
49	34.6	34.6	09	77.1	77.1	69	119.5	119.5	29	161.9	161.9	89	204.4	204.4
50	35.4	35.4	10	77.8	77.8	70	120.2	120.2	30	162.6	162.6	90	205.1	205.1
51	36.1	36.1	111	78.5	78.5	171	120.9	120.9	231	163.3	163.3	291	205.8	205.8
52	36.8	36.8	12	79.2	79.2	72	121.6	121.6	32	164.0	164.0	92	206.5	206.5
53	37.5	37.5	13	79.9	79.9	73	122.3	122.3	33	164.8	164.8	93	207.2	207.2
54	38.2	38.2	14	80.6	80.6	74	123.0	123.0	34	165.5	165.5	94	207.9	207.9
55	38.9	38.9	15	81.3	81.3	75	123.7	123.7	35	166.2	166.2	95	208.6	208.6
56	39.6	39.6	16	82.0	82.0	76	124.5	124.5	36	166.9	166.9	96	209.3	209.3
57	40.3	40.3	17	82.7	82.7	77	125.2	125.2	37	167.6	167.6	97	210.0	210.0
58	41.0	41.0	18	83.4	83.4	78	125.9	125.9	38	168.3	168.3	98	210.7	210.7
59	41.7	41.7	19	84.1	84.1	79	126.6	126.6	39	169.0	169.0	99	211.4	211.4
60	42.4	42.4	20	84.9	84.9	80	127.3	127.3	40	169.7	169.7	300	212.1	212.1
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 4 Points.

TABLE I. Difference of Latitude and Departure for 2 ¾ Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.5	61	52.3	31.4	121	103.8	62.2	181	155.2	93.1	241	206.7	123.9
2	01.7	01.0	62	53.2	31.9	22	104.6	62.7	82	156.1	93.6	42	207.6	124.4
3	02.6	01.5	63	54.0	32.4	23	105.5	63.2	83	157.0	94.1	43	208.4	124.9
4	03.4	02.1	64	54.9	32.9	24	106.4	63.7	84	157.8	94.6	44	209.3	125.4
5	04.3	02.6	65	55.8	33.4	25	107.2	64.3	85	158.7	95.1	45	210.1	126.0
6	05.1	03.1	66	56.6	33.9	26	108.1	64.8	86	159.5	95.6	46	211.0	126.5
7	06.0	03.6	67	57.5	34.4	27	108.9	65.3	87	160.4	96.1	47	211.9	127.0
8	06.9	04.1	68	58.3	35.0	28	109.8	65.8	88	161.3	96.7	48	212.7	127.5
9	07.7	04.6	69	59.2	35.5	29	110.6	66.3	89	162.1	97.2	49	213.6	128.0
10	08.6	05.1	70	60.0	36.0	30	111.5	66.8	90	163.0	97.7	50	214.4	128.5
11	09.4	05.7	71	60.9	36.5	131	112.4	67.3	191	163.8	98.2	251	215.3	129.0
12	10.3	06.2	72	61.8	37.0	32	113.2	67.9	92	164.7	98.7	52	216.1	129.6
13	11.2	06.7	73	62.6	37.5	33	114.1	68.4	93	165.5	99.2	53	217.0	130.1
14	12.0	07.2	74	63.5	38.1	34	114.9	68.9	94	166.4	99.7	54	217.9	130.6
15	12.9	07.7	75	64.3	38.6	35	115.8	69.4	95	167.3	100.2	55	218.7	131.1
16	13.7	08.2	76	65.2	39.1	36	116.7	69.9	96	168.1	100.8	56	219.6	131.6
17	14.6	08.7	77	66.0	39.6	37	117.5	70.4	97	169.0	101.3	57	220.4	132.1
18	15.4	09.3	78	66.9	40.1	38	118.4	70.9	98	169.8	101.8	58	221.3	132.6
19	16.3	09.8	79	67.8	40.6	39	119.2	71.5	99	170.7	102.3	59	222.2	133.2
20	17.2	10.3	80	68.6	41.1	40	120.1	72.0	200	171.5	102.8	60	223.0	133.7
21	18.0	10.8	81	69.5	41.6	141	120.9	72.5	201	172.4	103.3	261	223.9	134.2
22	18.9	11.3	82	70.3	42.2	42	121.8	73.0	02	173.3	103.8	62	224.7	134.7
23	19.7	11.8	83	71.2	42.7	43	122.7	73.5	03	174.1	104.4	63	225.6	135.2
24	20.6	12.3	84	72.0	43.2	44	123.5	74.0	04	175.0	104.9	64	226.4	135.7
25	21.4	12.9	85	72.9	43.7	45	124.4	74.5	05	175.8	105.4	65	227.3	136.2
26	22.3	13.4	86	73.8	44.2	46	125.2	75.1	06	176.7	105.9	66	228.2	136.7
27	23.2	13.9	87	74.6	44.7	47	126.1	75.6	07	177.5	106.4	67	229.0	137.3
28	24.0	14.4	88	75.5	45.2	48	126.9	76.1	08	178.4	106.9	68	229.9	137.8
29	24.9	14.9	89	76.3	45.8	49	127.8	76.6	09	179.3	107.4	69	230.7	138.3
30	25.7	15.4	90	77.2	46.3	50	128.7	77.1	10	180.1	108.0	70	231.6	138.8
31	26.6	15.9	91	78.1	46.8	151	129.5	77.6	211	181.0	108.5	271	232.4	139.3
32	27.4	16.5	92	78.9	47.3	52	130.4	78.1	12	181.8	109.0	72	233.3	139.8
33	28.3	17.0	93	79.8	47.8	53	131.2	78.7	13	182.7	109.5	73	234.2	140.3
34	29.2	17.5	94	80.6	48.3	54	132.1	79.2	14	183.6	110.0	74	235.0	140.9
35	30.0	18.0	95	81.5	48.8	55	132.9	79.7	15	184.4	110.5	75	235.9	141.4
36	30.9	18.5	96	82.3	49.4	56	133.8	80.2	16	185.3	111.0	76	236.7	141.9
37	31.7	19.0	97	83.2	49.9	57	134.7	80.7	17	186.1	111.6	77	237.6	142.4
38	32.6	19.5	98	84.1	50.4	58	135.5	81.2	18	187.0	112.1	78	238.4	142.9
39	33.5	20.0	99	84.9	50.9	59	136.4	81.7	19	187.8	112.6	79	239.3	143.4
40	34.3	20.6	100	85.8	51.4	60	137.2	82.3	20	188.7	113.1	80	240.2	143.9
41	35.2	21.1	101	86.6	51.9	161	138.1	82.8	221	189.6	113.6	281	241.0	144.5
42	36.0	21.6	02	87.5	52.4	62	139.0	83.3	22	190.4	114.1	82	241.9	145.0
43	36.9	22.1	03	88.3	52.9	63	139.8	83.8	23	191.3	114.6	83	242.7	145.5
44	37.7	22.6	04	89.2	53.5	64	140.7	84.3	24	192.1	115.2	84	243.6	146.0
45	38.6	23.1	05	90.1	54.0	65	141.5	84.8	25	193.0	115.7	85	244.5	146.5
46	39.5	23.6	06	90.9	54.5	66	142.4	85.3	26	193.8	116.2	86	245.3	147.0
47	40.3	24.2	07	91.8	55.0	67	143.2	85.9	27	194.7	116.7	87	246.2	147.5
48	41.2	24.7	08	92.6	55.5	68	144.1	86.4	28	195.6	117.2	88	247.0	148.1
49	42.0	25.2	09	93.5	56.0	69	145.0	86.9	29	196.4	117.7	89	247.9	148.6
50	42.9	25.7	10	94.4	56.6	70	145.8	87.4	30	197.3	118.2	90	248.7	149.1
51	43.7	26.2	111	95.2	57.1	171	146.7	87.9	231	198.1	118.7	291	249.6	149.6
52	44.6	26.7	12	96.1	57.6	72	147.5	88.4	32	199.0	119.2	92	250.5	150.1
53	45.5	27.2	13	96.9	58.1	73	148.4	88.9	33	199.9	119.8	93	251.3	150.6
54	46.3	27.8	14	97.8	58.6	74	149.2	89.5	34	200.7	120.3	94	252.2	151.1
55	47.2	28.3	15	98.6	59.1	75	150.1	89.8	35	201.6	120.8	95	253.0	151.7
56	48.0	28.8	16	99.5	59.6	76	151.0	90.5	36	202.4	121.3	96	253.9	152.2
57	48.9	29.3	17	100.4	60.1	77	151.8	91.0	37	203.3	121.8	97	254.7	152.7
58	49.7	29.8	18	101.2	60.7	78	152.7	91.5	38	204.1	122.4	98	255.6	153.2
59	50.6	30.3	19	102.1	61.2	79	153.5	92.0	39	205.0	122.9	99	256.5	153.7
60	51.5	30.8	20	102.9	61.7	80	154.4	92.5	40	205.9	123.4	300	257.3	154.2
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 5 ¼ Points.

TABLE II. Difference of Latitude and Departure for 2 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.0	61	61.0	02.1	121	120.9	04.2	181	180.9	06.3	241	240.9	08.4
2	02.0	00.1	62	62.0	02.2	22	121.9	04.3	82	181.9	06.4	42	241.9	08.4
3	03.0	00.1	63	63.0	02.2	23	122.9	04.3	83	182.9	06.4	43	242.9	08.5
4	04.0	00.1	64	64.0	02.2	24	123.9	04.3	84	183.9	06.4	44	243.9	08.5
5	05.0	00.2	65	65.0	02.3	25	124.9	04.4	85	184.9	06.5	45	244.9	08.6
6	06.0	00.2	66	66.0	02.3	26	125.9	04.4	86	185.9	06.5	46	245.9	08.6
7	07.0	00.2	67	67.0	02.3	27	126.9	04.4	87	186.9	06.5	47	246.8	08.6
8	08.0	00.3	68	68.0	02.4	28	127.9	04.5	88	187.9	06.6	48	247.8	08.7
9	09.0	00.3	69	69.0	02.4	29	128.9	04.5	89	188.9	06.6	49	248.8	08.7
10	10.0	00.3	70	70.0	02.4	30	129.9	04.5	90	189.9	06.6	50	249.8	08.7
11	11.0	00.4	71	71.0	02.5	131	130.9	04.6	191	190.9	06.7	251	250.8	08.8
12	12.0	00.4	72	72.0	02.5	32	131.9	04.6	92	191.9	06.7	52	251.8	08.8
13	13.0	00.5	73	73.0	02.5	33	132.9	04.6	93	192.9	06.7	53	252.8	08.8
14	14.0	00.5	74	74.0	02.6	34	133.9	04.7	94	193.9	06.8	54	253.8	08.9
15	15.0	00.5	75	75.0	02.6	35	134.9	04.7	95	194.9	06.8	55	254.8	08.9
16	16.0	00.6	76	76.0	02.7	36	135.9	04.8	96	195.9	06.8	56	255.8	08.9
17	17.0	00.6	77	77.0	02.7	37	136.9	04.8	97	196.9	06.9	57	256.8	09.0
18	18.0	00.6	78	78.0	02.7	38	137.9	04.8	98	197.9	06.9	58	257.8	09.0
19	19.0	00.7	79	79.0	02.8	39	138.9	04.9	99	198.9	06.9	59	258.8	09.0
20	20.0	00.7	80	80.0	02.8	40	139.9	04.9	200	199.9	07.0	60	259.8	09.1
21	21.0	00.7	81	81.0	02.8	141	140.9	04.9	201	200.9	07.0	261	260.8	09.1
22	22.0	00.8	82	82.0	02.9	42	141.9	05.0	02	201.9	07.0	62	261.8	09.1
23	23.0	00.8	83	82.9	02.9	43	142.9	05.0	03	202.9	07.1	63	262.8	09.2
24	24.0	00.8	84	83.9	02.9	44	143.9	05.0	04	203.9	07.1	64	263.8	09.2
25	25.0	00.9	85	84.9	03.0	45	144.9	05.1	05	204.9	07.2	65	264.8	09.2
26	26.0	00.9	86	85.9	03.0	46	145.9	05.1	06	205.9	07.2	66	265.8	09.3
27	27.0	00.9	87	86.9	03.0	47	146.9	05.1	07	206.9	07.2	67	266.8	09.3
28	28.0	01.0	88	87.9	03.1	48	147.9	05.2	08	207.9	07.3	68	267.8	09.4
29	29.0	01.0	89	88.9	03.1	49	148.9	05.2	09	208.9	07.3	69	268.8	09.4
30	30.0	01.0	90	89.9	03.1	50	149.9	05.2	10	209.9	07.3	70	269.8	09.4
31	31.0	01.1	91	90.9	03.2	151	150.9	05.3	211	210.9	07.4	271	270.8	09.5
32	32.0	01.1	92	91.9	03.2	52	151.9	05.3	12	211.9	07.4	72	271.8	09.5
33	33.0	01.2	93	92.9	03.2	53	152.9	05.3	13	212.9	07.4	73	272.8	09.5
34	34.0	01.2	94	93.9	03.3	54	153.9	05.4	14	213.9	07.5	74	273.8	09.6
35	35.0	01.2	95	94.9	03.3	55	154.9	05.4	15	214.9	07.5	75	274.8	09.6
36	36.0	01.3	96	95.9	03.4	56	155.9	05.4	16	215.9	07.5	76	275.8	09.6
37	37.0	01.3	97	96.9	03.4	57	156.9	05.5	17	216.9	07.6	77	276.8	09.7
38	38.0	01.3	98	97.9	03.4	58	157.9	05.5	18	217.9	07.6	78	277.8	09.7
39	39.0	01.4	99	98.9	03.5	59	158.9	05.5	19	218.9	07.6	79	278.8	09.7
40	40.0	01.4	100	99.9	03.5	60	159.9	05.6	20	219.9	07.7	80	279.8	09.8
41	41.0	01.4	101	100.9	03.5	161	160.9	05.6	221	220.9	07.7	281	280.8	09.8
42	42.0	01.5	02	101.9	03.6	62	161.9	05.7	22	221.9	07.7	82	281.8	09.8
43	43.0	01.5	03	102.9	03.6	63	162.9	05.7	23	222.9	07.8	83	282.8	09.9
44	44.0	01.5	04	103.9	03.6	64	163.9	05.7	24	223.9	07.8	84	283.8	09.9
45	45.0	01.6	05	104.9	03.7	65	164.9	05.8	25	224.9	07.9	85	284.8	09.9
46	46.0	01.6	06	105.9	03.7	66	165.9	05.8	26	225.9	07.9	86	285.8	10.0
47	47.0	01.6	07	106.9	03.7	67	166.9	05.8	27	226.9	07.9	87	286.8	10.0
48	48.0	01.7	08	107.9	03.8	68	167.9	05.9	28	227.9	08.0	88	287.8	10.1
49	49.0	01.7	09	108.9	03.8	69	168.9	05.9	29	228.9	08.0	89	288.8	10.1
50	50.0	01.7	10	109.9	03.8	70	169.9	05.9	30	229.9	08.0	90	289.8	10.1
51	51.0	01.8	111	110.9	03.9	171	170.9	06.0	231	230.9	08.1	291	290.8	10.2
52	52.0	01.8	12	111.9	03.9	72	171.9	06.0	32	231.9	08.1	92	291.8	10.2
53	53.0	01.8	13	112.9	03.9	73	172.9	06.0	33	232.9	08.1	93	292.8	10.2
54	54.0	01.9	14	113.9	04.0	74	173.9	06.1	34	233.9	08.2	94	293.8	10.3
55	55.0	01.9	15	114.9	04.0	75	174.9	06.1	35	234.9	08.2	95	294.8	10.3
56	56.0	02.0	16	115.9	04.0	76	175.9	06.1	36	235.9	08.2	96	295.8	10.3
57	57.0	02.0	17	116.9	04.1	77	176.9	06.2	37	236.9	08.3	97	296.8	10.4
58	58.0	02.0	18	117.9	04.1	78	177.9	06.2	38	237.9	08.3	98	297.8	10.4
59	59.0	02.1	19	118.9	04.2	79	178.9	06.2	39	238.9	08.3	99	208.8	10.4
60	60.0	02.1	20	119.9	04.2	80	179.9	06.3	40	239.9	08.4	300	299.8	10.5
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 88 Degrees.

TABLE I. Difference of Latitude and Departure for 3 ¼ Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	49.0	36.3	121	97.2	72.1	181	145.4	107.8	241	193.6	143.6
2	01.6	01.2	62	49.8	36.9	22	98.0	72.7	82	146.2	108.4	42	194.4	144.2
3	02.4	01.8	63	50.6	37.5	23	98.8	73.3	83	147.0	109.0	43	195.2	144.8
4	03.2	02.4	64	51.4	38.1	24	99.6	73.9	84	147.8	109.6	44	196.0	145.4
5	04.0	03.0	65	52.2	38.7	25	100.4	74.5	85	148.6	110.2	45	196.8	145.9
6	04.8	03.6	66	53.0	39.3	26	101.2	75.1	86	149.4	110.8	46	197.6	146.5
7	05.6	04.2	67	53.8	39.9	27	102.0	75.7	87	150.2	111.4	47	198.4	147.1
8	06.4	04.8	68	54.6	40.5	28	102.8	76.2	88	151.0	112.0	48	199.2	147.7
9	07.2	05.4	69	55.4	41.1	29	103.6	76.8	89	151.8	112.6	49	200.0	148.3
10	08.0	06.0	70	56.2	41.7	30	104.4	77.4	90	152.6	113.2	50	200.8	148.9
11	08.8	06.6	71	57.0	42.3	131	105.2	78.0	191	153.4	113.8	251	201.6	149.5
12	09.6	07.1	72	57.8	42.9	32	106.0	78.6	92	154.2	114.4	52	202.4	150.1
13	10.4	07.7	73	58.6	43.5	33	106.8	79.2	93	155.0	115.0	53	203.2	150.7
14	11.2	08.3	74	59.4	44.1	34	107.6	79.8	94	155.8	115.6	54	204.0	151.3
15	12.0	08.9	75	60.2	44.7	35	108.4	80.4	95	156.6	116.2	55	204.8	151.9
16	12.9	09.5	76	61.0	45.3	36	109.2	81.0	96	157.4	116.8	56	205.6	152.5
17	13.7	10.1	77	61.8	45.9	37	110.0	81.6	97	158.2	117.4	57	206.4	153.1
18	14.5	10.7	78	62.7	46.5	38	110.8	82.2	98	159.0	117.9	58	207.2	153.7
19	15.3	11.3	79	63.5	47.1	39	111.6	82.8	99	159.8	118.5	59	208.0	154.3
20	16.1	11.9	80	64.3	47.7	40	112.4	83.4	200	160.6	119.1	60	208.8	154.9
21	16.9	12.5	81	65.1	48.3	141	113.2	84.0	201	161.4	119.7	261	209.6	155.5
22	17.7	13.1	82	65.9	48.8	42	114.0	84.6	02	162.2	120.3	62	210.4	156.1
23	18.5	13.7	83	66.7	49.4	43	114.9	85.2	03	163.1	120.9	63	211.2	156.7
24	19.3	14.3	84	67.5	50.0	44	115.7	85.8	04	163.9	121.5	64	212.0	157.3
25	20.1	14.9	85	68.3	50.6	45	116.5	86.4	05	164.7	122.1	65	212.8	157.9
26	20.9	15.5	86	69.1	51.2	46	117.2	87.0	06	165.5	122.7	66	213.7	158.5
27	21.7	16.1	87	69.9	51.8	47	118.0	87.6	07	166.3	123.3	67	214.5	159.1
28	22.5	16.7	88	70.7	52.4	48	118.9	88.2	08	167.1	123.9	68	215.3	159.6
29	23.3	17.3	89	71.5	53.0	49	119.7	88.8	09	167.9	124.5	69	216.1	160.2
30	24.1	17.9	90	72.3	53.6	50	120.5	89.4	10	168.7	125.1	70	216.9	160.8
31	24.9	18.5	91	73.1	54.2	151	121.3	90.0	211	169.5	125.7	271	217.7	161.4
32	25.7	19.1	92	73.9	54.8	52	122.1	90.5	12	170.3	126.3	72	218.5	162.0
33	26.5	19.7	93	74.7	55.4	53	122.9	91.1	13	171.1	126.9	73	219.3	162.6
34	27.3	20.3	94	75.5	56.0	54	123.7	91.7	14	171.9	127.5	74	220.1	163.2
35	28.1	20.8	95	76.3	56.6	55	124.5	92.3	15	172.7	128.1	75	220.9	163.8
36	28.9	21.4	96	77.1	57.2	56	125.3	92.9	16	173.5	128.7	76	221.7	164.4
37	29.7	22.0	97	77.9	57.8	57	126.1	93.5	17	174.3	129.3	77	222.5	165.0
38	30.5	22.6	98	78.7	58.4	58	126.9	94.1	18	175.1	129.9	78	223.3	165.6
39	31.3	23.2	99	79.5	59.0	59	127.7	94.7	19	175.9	130.5	79	224.1	166.2
40	32.1	23.8	100	80.3	59.6	60	128.5	95.3	20	176.7	131.1	80	224.9	166.8
41	32.9	24.4	101	81.1	60.2	161	129.3	95.9	221	177.5	131.6	281	225.7	167.4
42	33.7	25.0	02	81.9	60.8	62	130.1	96.5	22	178.3	132.2	82	226.5	168.0
43	34.5	25.6	03	82.7	61.4	63	130.9	97.1	23	179.1	132.8	83	227.3	168.6
44	35.3	26.2	04	83.5	62.0	64	131.7	97.7	24	179.9	133.4	84	228.1	169.2
45	36.1	26.8	05	84.3	62.5	65	132.5	98.3	25	180.7	134.0	85	228.9	169.8
46	36.9	27.4	06	85.1	63.1	66	133.3	98.9	26	181.5	134.6	86	229.7	170.4
47	37.8	28.0	07	85.9	63.7	67	134.1	99.5	27	182.3	135.2	87	230.5	171.0
48	38.6	28.6	08	86.7	64.3	68	134.9	100.1	28	183.1	135.8	88	231.3	171.6
49	39.4	29.2	09	87.5	64.9	69	135.7	100.7	29	183.9	136.4	89	232.1	172.2
50	40.2	29.8	10	88.4	65.5	70	136.5	101.3	30	184.7	137.0	90	232.9	172.8
51	41.0	30.4	111	89.2	66.1	171	137.3	101.9	231	185.5	137.6	291	233.7	173.3
52	41.8	31.0	12	90.0	66.7	72	138.2	102.5	32	186.3	138.2	92	234.5	173.9
53	42.6	31.6	13	90.8	67.3	73	139.0	103.1	33	187.1	138.8	93	235.3	174.5
54	43.4	32.2	14	91.6	67.9	74	139.8	103.7	34	188.0	139.4	94	236.1	175.1
55	44.2	32.8	15	92.4	68.5	75	140.6	104.2	35	188.8	140.0	95	236.9	175.7
56	45.0	33.4	16	93.2	69.1	76	141.4	104.8	36	189.6	140.6	96	237.7	176.3
57	45.8	34.0	17	94.0	69.7	77	142.2	105.4	37	190.4	141.2	97	238.6	176.9
58	46.6	34.6	18	94.8	70.3	78	143.0	106.0	38	191.2	141.8	98	239.4	177.5
59	47.4	35.1	19	95.6	70.9	79	143.8	106.6	39	192.0	142.4	99	240.2	178.1
60	48.2	35.7	20	96.4	71.5	80	144.6	107.2	40	192.8	143.0	300	241.0	178.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 4 ¾ Points.

Difference of Latitude and Departure for 4 Degrees.

ist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
61	60.9	04.3	121	120.7	08.4	181	180.6	12.6	241	240.4	16.8
62	61.8	04.3	22	121.7	08.5	82	181.6	12.7	42	241.4	16.9
63	62.8	04.4	23	122.7	08.6	83	182.6	12.8	43	242.4	17.0
64	63.8	04.5	24	123.7	08.6	84	183.6	12.8	44	243.4	17.0
65	64.8	04.5	25	124.7	08.7	85	184.6	12.9	45	244.4	17.1
66	65.8	04.6	26	125.7	08.8	86	185.5	13.0	46	245.4	17.2
67	66.8	04.7	27	126.7	08.9	87	186.5	13.0	47	246.4	17.2
68	67.8	04.7	28	127.7	08.9	88	187.5	13.1	48	247.4	17.3
69	68.8	04.8	29	128.7	09.0	89	188.5	13.2	49	248.4	17.4
70	69.8	04.9	30	129.7	09.1	90	189.5	13.3	50	249.4	17.4
71	70.8	05.0	131	130.7	09.1	191	190.5	13.3	251	250.4	17.5
72	71.8	05.0	32	131.7	09.2	92	191.5	13.4	52	251.4	17.6
73	72.8	05.1	33	132.7	09.3	93	192.5	13.5	53	252.4	17.6
74	73.8	05.2	34	133.7	09.3	94	193.5	13.5	54	253.4	17.7
75	74.8	05.2	35	134.7	09.4	95	194.5	13.6	55	254.4	17.8
76	75.8	05.3	36	135.7	09.5	96	195.5	13.7	56	255.4	17.9
77	76.8	05.4	37	136.7	09.6	97	196.5	13.7	57	256.4	17.9
78	77.8	05.4	38	137.7	09.6	98	197.5	13.8	58	257.4	18.0
79	78.8	05.5	39	138.7	09.7	99	198.5	13.9	59	258.4	18.1
80	79.8	05.6	40	139.7	09.8	200	199.5	14.0	60	259.4	18.1
81	80.8	05.7	141	140.7	09.8	201	200.5	14.0	261	260.4	18.2
82	81.8	05.7	42	141.7	09.9	02	201.5	14.1	62	261.4	18.3
83	82.8	05.8	43	142.7	10.0	03	202.5	14.2	63	262.4	18.3
84	83.8	05.9	44	143.6	10.0	04	203.5	14.2	64	263.4	18.4
85	84.8	05.9	45	144.6	10.1	05	204.5	14.3	65	264.4	18.5
86	85.8	06.0	46	145.6	10.2	06	205.5	14.4	66	265.4	18.6
87	86.8	06.1	47	146.6	10.3	07	206.5	14.4	67	266.3	18.6
88	87.8	06.1	48	147.6	10.3	08	207.5	14.5	68	267.3	18.7
89	88.8	06.2	49	148.6	10.4	09	208.5	14.6	69	268.3	18.8
90	89.8	06.3	50	149.6	10.5	10	209.5	14.6	70	269.3	18.8
91	90.8	06.3	151	150.6	10.5	211	210.5	14.7	271	270.3	18.9

TABLE I. Difference of Latitude and Departure for 3 ¼ Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.7	00.7	61	45.2	41.0	121	89.7	81.3	181	134.1	121.6	241	178.6	161.8
2	01.5	01.3	62	45.9	41.6	22	90.4	81.9	82	134.9	122.2	42	179.3	162.5
3	02.2	02.0	63	46.7	42.3	23	91.1	82.6	83	135.6	122.9	43	180.1	163.2
4	03.0	02.7	64	47.4	43.0	24	91.9	83.3	84	136.3	123.6	44	180.8	163.9
5	03.7	03.4	65	48.2	43.7	25	92.6	83.9	85	137.1	124.2	45	181.5	164.5
6	04.4	04.0	66	48.9	44.3	26	93.4	84.6	86	137.8	124.9	46	182.3	165.2
7	05.2	04.7	67	49.6	45.0	27	94.1	85.3	87	138.6	125.6	47	183.0	165.9
8	05.9	05.4	68	50.4	45.7	28	94.8	86.0	88	139.3	126.3	48	183.8	166.5
9	06.7	06.0	69	51.1	46.3	29	95.6	86.6	89	140.0	126.9	49	184.5	167.2
10	07.4	06.7	70	51.9	47.0	30	96.3	87.3	90	140.7	127.6	50	185.2	167.9
11	08.2	07.4	71	52.6	47.7	131	97.1	88.0	191	141.5	128.3	251	186.0	168.6
12	08.9	08.1	72	53.3	48.4	32	97.8	88.6	92	142.3	128.9	52	186.7	169.2
13	09.6	08.7	73	54.1	49.0	33	98.5	89.3	93	143.0	129.6	53	187.5	169.9
14	10.4	09.4	74	54.8	49.7	34	99.3	90.0	94	143.7	130.3	54	188.2	170.6
15	11.1	10.1	75	55.6	50.4	35	100.0	90.7	95	144.5	131.0	55	188.9	171.2
16	11.9	10.7	76	56.3	51.0	36	100.8	91.3	96	145.2	131.6	56	189.7	171.9
17	12.6	11.4	77	57.1	51.7	37	101.5	92.0	97	146.0	132.3	57	190.4	172.6
18	13.3	12.1	78	57.8	52.4	38	102.3	92.7	98	146.7	133.0	58	191.2	173.3
19	14.1	12.8	79	58.5	53.1	39	103.0	93.3	99	147.4	133.6	59	191.9	173.9
20	14.8	13.4	80	59.3	53.7	40	103.7	94.0	200	148.2	134.3	60	192.6	174.6
21	15.6	14.1	81	60.0	54.4	141	104.5	94.7	201	148.9	135.0	261	193.4	175.3
22	16.3	14.8	82	60.8	55.1	42	105.2	95.4	02	149.7	135.7	62	194.1	175.9
23	17.0	15.4	83	61.5	55.7	43	106.0	96.0	03	150.4	136.3	63	194.9	176.6
24	17.8	16.1	84	62.2	56.4	44	106.7	96.7	04	151.2	137.0	64	195.6	177.3
25	18.5	16.8	85	63.0	57.1	45	107.4	97.4	05	151.9	137.7	65	196.4	178.0
26	19.3	17.5	86	63.7	57.8	46	108.2	98.0	06	152.6	138.3	66	197.1	178.6
27	20.0	18.1	87	64.5	58.4	47	108.9	98.7	07	153.4	139.0	67	197.8	179.3
28	20.7	18.8	88	65.2	59.1	48	109.8	99.4	08	154.1	139.7	68	198.6	180.0
29	21.5	19.5	89	65.9	59.8	49	110.4	100.1	09	154.9	140.4	69	199.3	180.6
30	22.2	20.1	90	66.7	60.4	50	111.1	100.7	10	155.6	141.0	70	200.1	181.3
31	23.0	20.8	91	67.4	61.1	151	111.9	101.4	211	156.3	141.7	271	200.8	182.0
32	23.7	21.5	92	68.2	61.8	52	112.6	102.1	12	157.1	142.4	72	201.5	182.7
33	24.4	22.2	93	68.9	62.5	53	113.4	102.7	13	157.8	143.0	73	202.3	183.3
34	25.2	22.8	94	69.6	63.1	54	114.1	103.4	14	158.6	143.7	74	203.0	184.0
35	25.9	23.5	95	70.4	63.8	55	114.8	104.1	15	159.3	144.4	75	203.8	184.7
36	26.7	24.2	96	71.1	64.5	56	115.6	104.8	16	160.0	145.1	76	204.5	185.4
37	27.4	24.8	97	71.9	65.1	57	116.3	105.4	17	160.8	145.7	77	205.2	186.0
38	28.2	25.5	98	72.6	65.8	58	117.1	106.1	18	161.5	146.4	78	206.0	186.7
39	28.9	26.2	99	73.4	66.5	59	117.8	106.8	19	162.3	147.1	79	206.7	187.4
40	29.6	26.9	100	74.1	67.2	60	118.6	107.4	20	163.0	147.7	80	207.5	188.0
41	30.4	27.5	101	74.8	67.8	161	119.3	108.1	221	163.8	148.4	281	208.2	188.7
42	31.1	28.2	02	75.6	68.5	62	120.0	108.8	22	164.5	149.1	82	208.9	189.4
43	31.9	28.9	03	76.3	69.2	63	120.8	109.5	23	165.2	149.8	83	209.7	190.1
44	32.6	29.5	04	77.1	69.8	64	121.5	110.1	24	166.0	150.4	84	210.4	190.7
45	33.3	30.2	05	77.8	70.5	65	122.3	110.8	25	166.7	151.1	85	211.2	191.4
46	34.1	30.9	06	78.5	71.2	66	123.0	111.5	26	167.5	151.8	86	211.9	192.1
47	34.8	31.6	07	79.3	71.9	67	123.7	112.2	27	168.2	152.4	87	212.7	192.7
48	35.6	32.2	08	80.0	72.5	68	124.5	112.8	28	168.9	153.1	88	213.4	193.4
49	36.3	32.9	09	80.8	73.2	69	125.2	113.5	29	169.7	153.8	89	214.1	194.1
50	37.0	33.6	10	81.5	73.9	70	126.0	114.2	30	170.4	154.5	90	214.9	194.8
51	37.8	34.2	111	82.2	74.5	171	126.7	114.8	231	171.2	155.1	291	215.6	195.4
52	38.5	34.9	12	83.0	75.2	72	127.4	115.5	32	171.9	155.8	92	216.4	196.1
53	39.3	35.6	13	83.7	75.9	73	128.2	116.2	33	172.6	156.5	93	217.1	196.8
54	40.0	36.3	14	84.5	76.6	74	128.9	116.9	34	173.4	157.1	94	217.8	197.4
55	40.8	36.9	15	85.2	77.2	75	129.7	117.5	35	174.1	157.8	95	218.6	198.1
56	41.5	37.6	16	86.0	77.9	76	130.4	118.2	36	174.9	158.5	96	219.3	198.8
57	42.2	38.3	17	86.7	78.6	77	131.1	118.9	37	175.6	159.2	97	220.1	199.5
58	43.0	39.0	18	87.4	79.2	78	131.9	119.5	38	176.3	159.8	98	220.9	200.1
59	43.7	39.6	19	88.2	79.9	79	132.6	120.2	39	177.1	160.5	99	221.5	200.8
60	44.5	40.3	20	88.9	80.6	80	133.4	120.9	40	177.8	161.2	300	222.3	201.5
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 4 ¾ Points.

I. Difference of Latitude and Departure for 6 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
61	60.7	06.4	121	120.3	12.6	181	180.0	18.9	241	239.7	25.2
62	61.7	06.5	22	121.3	12.8	82	181.0	19.0	42	240.7	25.3
63	62.7	06.6	23	122.3	12.9	83	182.0	19.1	43	241.7	25.4
64	63.6	06.7	24	123.3	13.0	84	183.0	19.2	44	242.7	25.5
65	64.6	06.8	25	124.3	13.1	85	184.0	19.3	45	243.7	25.6
66	65.6	06.9	26	125.3	13.2	86	185.0	19.4	46	244.7	25.7
67	66.6	07.0	27	126.3	13.3	87	186.0	19.5	47	245.6	25.8
68	67.6	07.1	28	127.3	13.4	88	187.0	19.7	48	246.6	25.9
69	68.6	07.2	29	128.3	13.5	89	188.0	19.8	49	247.6	26.0
70	69.6	07.3	30	129.3	13.6	90	189.0	19.9	50	248.6	26.1
71	70.6	07.4	131	130.3	13.7	191	190.0	20.0	251	249.6	26.2
72	71.6	07.5	32	131.3	13.8	92	190.9	20.1	52	250.6	26.3
73	72.6	07.6	33	132.3	13.9	93	191.5	20.2	53	251.6	26.4
74	73.6	07.7	34	133.3	14.0	94	192.9	20.3	54	252.6	26.6
75	74.6	07.8	35	134.3	14.1	95	193.9	20.4	55	253.6	26.7
76	75.6	07.9	36	135.3	14.2	96	194.9	20.5	56	254.6	26.8
77	76.6	08.0	37	136.2	14.3	97	195.9	20.6	57	255.6	26.9
78	77.6	08.2	38	137.2	14.4	98	196.9	20.7	58	256.6	27.0
79	78.6	08.3	39	138.2	14.5	99	197.9	20.8	59	257.6	27.1
80	79.6	08.4	40	139.2	14.6	200	198.9	20.9	60	258.6	27.2
81	80.6	08.5	141	140.2	14.7	201	199.9	21.0	261	259.[illegible]	27.3
82	81.6	08.6	42	141.2	14.8	02	200.9	21.1	62	260.[illegible]	27.4
83	82.5	08.7	43	142.2	14.9	03	201.9	21.2	63	[illegible]	27.5
84	83.5	08.8	44	143.2	15.0	04	202.9	21.3	64	262.6	27.6
85	84.5	08.9	45	144.2	15.1	05	203.9	21.4	65	[illegible]	27.7
86	85.5	09.0	46	145.2	15.3	06	204.9	21.5	66	[illegible]	27.8
87	86.5	09.1	47	146.2	15.4	07	205.9	21.6	67	[illegible]	27.9
88	87.5	09.2	48	147.2	15.5	08	206.9	21.7	68	266.5	28.0
89	88.5	09.3	49	148.2	15.6	09	207.9	21.8	69	267.5	28.1
90	89.5	09.4	50	149.2	15.7	10	208.8	22.0	70	268.5	28.2
91	90.5	09.5	151	150.2	15.8	211	209.8	22.1	271	269.5	28.3
92	91.5	09.6	52	151.2	15.9	12	210.8	22.2	72	270.5	28.4
93	92.5	09.7	53	152.2	16.0	13	211.8	22.3	73	271.5	28.5

TABLE II. Difference of Latitude and Departure for 1 Degree.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.0	61	61.0	01.1	121	121.0	02.1	181	181.0	03.2	241	241.0	04.2
2	02.0	00.0	62	62.0	01.1	22	122.0	02.1	82	182.0	03.2	42	242.0	04.2
3	03.0	00.1	63	63.0	01.1	23	123.0	02.1	83	183.0	03.2	43	243.0	04.2
4	04.0	00.1	64	64.0	01.1	24	124.0	02.2	84	184.0	03.2	44	244.0	04.3
5	05.0	00.1	65	65.0	01.1	25	125.0	02.2	85	185.0	03.2	45	245.0	04.3
6	06.0	00.1	66	66.0	01.2	26	126.0	02.2	86	186.0	03.2	46	246.0	04.3
7	07.0	00.1	67	67.0	01.2	27	127.0	02.2	87	187.0	03.3	47	247.0	04.3
8	08.0	00.1	68	68.0	01.2	28	128.0	02.2	88	188.0	03.3	48	248.0	04.3
9	09.0	00.2	69	69.0	01.2	29	129.0	02.2	89	189.0	03.3	49	249.0	04.3
10	10.0	00.2	70	70.0	01.2	30	130.0	02.3	90	190.0	03.3	50	250.0	04.4
11	11.0	00.2	71	71.0	01.2	131	131.0	02.3	191	191.0	03.3	251	251.0	04.4
12	12.0	00.2	72	72.0	01.3	32	132.0	02.3	92	192.0	03.4	52	252.0	04.4
13	13.0	00.2	73	73.0	01.3	33	133.0	02.3	93	193.0	03.4	53	253.0	04.4
14	14.0	00.2	74	74.0	01.3	34	134.0	02.3	94	194.0	03.4	54	254.0	04.4
15	15.0	00.3	75	75.0	01.3	35	135.0	02.3	95	195.0	03.4	55	255.0	04.5
16	16.0	00.3	76	76.0	01.3	36	136.0	02.4	96	196.0	03.4	56	256.0	04.5
17	17.0	00.3	77	77.0	01.3	37	137.0	02.4	97	197.0	03.4	57	257.0	04.5
18	18.0	00.3	78	78.0	01.4	38	138.0	02.4	98	198.0	03.5	58	258.0	04.5
19	19.0	00.3	79	79.0	01.4	39	139.0	02.4	99	199.0	03.5	59	259.0	04.5
20	20.0	00.3	80	80.0	01.4	40	140.0	02.4	200	200.0	03.5	60	260.0	04.5
21	21.0	00.4	81	81.0	01.4	141	141.0	02.5	201	201.0	03.5	261	261.0	04.6
22	22.0	00.4	82	82.0	01.4	42	142.0	02.5	02	202.0	03.5	62	262.0	04.6
23	23.0	00.4	83	83.0	01.5	43	143.0	02.5	03	203.0	03.5	63	263.0	04.6
24	24.0	00.4	84	84.0	01.5	44	144.0	02.5	04	204.0	03.6	64	264.0	04.6
25	25.0	00.4	85	85.0	01.5	45	145.0	02.5	05	205.0	03.6	65	265.0	04.6
26	26.0	00.5	86	86.0	01.5	46	146.0	02.5	06	206.0	03.6	66	266.0	04.6
27	27.0	00.5	87	87.0	01.5	47	147.0	02.6	07	207.0	03.6	67	267.0	04.7
28	28.0	00.5	88	88.0	01.5	48	148.0	02.6	08	208.0	03.6	68	268.0	04.7
29	29.0	00.5	89	89.0	01.6	49	149.0	02.6	09	209.0	03.6	69	269.0	04.7
30	30.0	00.5	90	90.0	01.6	50	150.0	02.6	10	210.0	03.7	70	270.0	04.7
31	31.0	00.5	91	91.0	01.6	151	151.0	02.6	211	211.0	03.7	271	271.0	04.7
32	32.0	00.6	92	92.0	01.6	52	152.0	02.7	12	212.0	03.7	72	272.0	04.7
33	33.0	00.6	93	93.0	01.6	53	153.0	02.7	13	213.0	03.7	73	273.0	04.8
34	34.0	00.6	94	94.0	01.6	54	154.0	02.7	14	214.0	03.7	74	274.0	04.8
35	35.0	00.6	95	95.0	01.7	55	155.0	02.7	15	215.0	03.8	75	275.0	04.8
36	36.0	00.6	96	96.0	01.7	56	156.0	02.7	16	216.0	03.8	76	276.0	04.8
37	37.0	00.6	97	97.0	01.7	57	157.0	02.7	17	217.0	03.8	77	277.0	04.8
38	38.0	00.7	98	98.0	01.7	58	158.0	02.8	18	218.0	03.8	78	278.0	04.9
39	39.0	00.7	99	99.0	01.7	59	159.0	02.8	19	219.0	03.8	79	279.0	04.9
40	40.0	00.7	100	100.0	01.7	60	160.0	02.8	20	220.0	03.8	80	280.0	04.9
41	41.0	00.7	101	101.0	01.8	161	161.0	02.8	221	221.0	03.9	281	281.0	04.9
42	42.0	00.7	02	102.0	01.8	62	162.0	02.8	22	222.0	03.9	82	282.0	04.9
43	43.0	00.8	03	103.0	01.8	63	163.0	02.8	23	223.0	03.9	83	283.0	04.9
44	44.0	00.8	04	104.0	01.8	64	164.0	02.9	24	224.0	03.9	84	284.0	05.0
45	45.0	00.8	05	105.0	01.8	65	165.0	02.9	25	225.0	03.9	85	285.0	05.0
46	46.0	00.8	06	106.0	01.8	66	166.0	02.9	26	226.0	03.9	86	286.0	05.0
47	47.0	00.8	07	107.0	01.9	67	167.0	02.9	27	227.0	04.0	87	287.0	05.0
48	48.0	00.8	08	108.0	01.9	68	168.0	02.9	28	228.0	04.0	88	288.0	05.0
49	49.0	00.9	09	109.0	01.9	69	169.0	02.9	29	229.0	04.0	89	289.0	05.0
50	50.0	00.9	10	110.0	01.9	70	170.0	03.0	30	230.0	04.0	90	290.0	05.1
51	51.0	00.9	111	111.0	01.9	171	171.0	03.0	231	231.0	04.0	291	291.0	05.1
52	52.0	00.9	12	112.0	01.9	72	172.0	03.0	32	232.0	04.0	92	292.0	05.1
53	53.0	00.9	13	113.0	02.0	73	173.0	03.0	33	233.0	04.1	93	293.0	05.1
54	54.0	00.9	14	114.0	02.0	74	174.0	03.0	34	234.0	04.1	94	294.0	05.1
55	55.0	01.0	15	115.0	02.0	75	175.0	03.0	35	235.0	04.1	95	295.0	05.1
56	56.0	01.0	16	116.0	02.0	76	176.0	03.1	36	236.0	04.1	96	296.0	05.2
57	57.0	01.0	17	117.0	02.0	77	177.0	03.1	37	237.0	04.1	97	297.0	05.2
58	58.0	01.0	18	118.0	02.1	78	178.0	03.1	38	238.0	04.2	98	298.0	05.2
59	59.0	01.0	19	119.0	02.1	79	179.0	03.1	39	239.0	04.2	99	299.0	05.2
60	60.0	01.1	20	120.0	02.1	80	180.0	03.1	40	240.0	04.2	300	300.0	05.2
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 89 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
61	60.4	08.5	121	119.8	16.8	181	179.2	25.2	241	238.7	33.5
62	61.4	08.6	22	120.8	17.0	82	180.2	25.3	42	239.7	33.7
63	62.4	08.8	23	121.8	17.1	83	181.2	25.5	43	240.6	33.8
64	63.4	08.9	24	122.8	17.3	84	182.2	25.6	44	241.6	34.0
65	64.4	09.0	25	123.8	17.4	85	183.2	25.7	45	242.6	34.1
66	65.4	09.2	26	124.8	17.5	86	184.2	25.9	46	243.6	34.2
67	66.3	09.3	27	125.8	17.7	87	185.2	26.0	47	244.6	34.4
68	67.3	09.5	28	126.8	17.8	88	186.2	26.2	48	245.6	34.5
69	68.3	09.6	29	127.7	18.0	89	187.2	26.3	49	246.6	34.7
70	69.3	09.7	30	128.7	18.1	90	188.2	26.4	50	247.6	34.8
71	70.3	09.9	131	129.7	18.2	191	189.1	26.6	251	248.6	34.9
72	71.3	10.0	32	130.7	18.4	92	190.1	26.7	52	249.5	35.1
73	72.3	10.2	33	131.7	18.5	93	191.1	26.9	53	250.5	35.2
74	73.3	10.3	34	132.7	18.6	94	192.1	27.0	54	251.5	35.3
75	74.3	10.4	35	133.7	18.8	95	193.1	27.1	55	252.5	35.5
76	75.3	10.6	36	134.7	18.9	96	194.1	27.3	56	253.5	35.6
77	76.3	10.7	37	135.7	19.1	97	195.1	27.4	57	254.5	35.8
78	77.2	10.9	38	136.7	19.2	98	196.1	27.6	58	255.5	35.9
79	78.2	11.0	39	137.7	19.3	99	197.1	27.7	59	256.5	36.0
80	79.2	11.1	40	138.6	19.5	200	198.1	27.8	60	257.5	36.2
81	80.2	11.3	141	139.6	19.6	201	199.0	28.0	261	258.5	36.3
82	81.2	11.4	42	140.6	19.8	02	200.0	28.1	62	259.5	36.5
83	82.2	11.6	43	141.6	19.9	03	201.0	28.3	63	260.4	36.6
84	83.2	11.7	44	142.6	20.0	04	202.0	28.4	64	261.4	36.7
85	84.2	11.8	45	143.6	20.2	05	203.0	28.5	65	262.4	36.9
86	85.2	12.0	46	144.6	20.3	06	204.0	28.7	66	263.4	37.0
87	86.2	12.1	47	145.6	20.5	07	205.0	28.8	67	264.4	37.2
88	87.1	12.2	48	146.6	20.6	08	206.0	28.9	68	265.4	37.3
89	88.1	12.4	49	147.5	20.7	09	207.0	29.1	69	266.4	37.4
90	89.1	12.5	50	148.5	20.9	10	208.0	29.2	70	267.4	37.6
91	90.1	12.7	151	149.5	21.0	211	208.9	29.4	271	268.4	37.7
92	91.1	12.8	52	150.5	21.2	12	209.9	29.5	72	269.4	37.9
93	92.1	12.9	53	151.5	21.3	13	210.9	29.6	73	270.3	38.0

TABLE II. Difference of Latitude and Departure for 3 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.1	61	60.9	03.2	121	120.8	06.3	181	180.7	09.5	241	240.7	12.6
2	02.0	00.1	62	61.9	03.2	22	121.8	06.4	82	181.7	09.5	42	241.7	12.7
3	03.0	00.2	63	62.9	03.3	23	122.8	06.4	83	182.7	09.6	43	242.7	12.7
4	04.0	00.2	64	63.9	03.3	24	123.8	06.5	84	183.7	09.6	44	243.7	12.8
5	05.0	00.3	65	64.9	03.4	25	124.8	06.5	85	184.7	09.7	45	244.7	12.8
6	06.0	00.3	66	65.9	03.5	26	125.8	06.6	86	185.7	09.7	46	245.7	12.9
7	07.0	00.4	67	66.9	03.5	27	126.8	06.6	87	186.7	09.8	47	246.7	12.9
8	08.0	00.4	68	67.9	03.6	28	127.8	06.7	88	187.7	09.8	48	247.7	13.0
9	09.0	00.5	69	68.9	03.6	29	128.8	06.8	89	188.7	09.9	49	248.7	13.0
10	10.0	00.5	70	69.9	03.7	30	129.8	06.8	90	189.7	09.9	50	249.7	13.1
11	11.0	00.6	71	70.9	03.7	131	130.8	06.9	191	190.7	10.0	251	250.7	13.1
12	12.0	00.6	72	71.9	03.8	32	131.8	06.9	92	191.7	10.0	52	251.7	13.2
13	13.0	00.7	73	72.9	03.8	33	132.8	07.0	93	192.7	10.1	53	252.7	13.2
14	14.0	00.7	74	73.9	03.9	34	133.8	07.0	94	193.7	10.2	54	253.7	13.3
15	15.0	00.8	75	74.9	03.9	35	134.8	07.1	95	194.7	10.2	55	254.7	13.3
16	16.0	00.8	76	75.9	04.0	36	135.8	07.1	96	195.7	10.3	56	255.6	13.4
17	17.0	00.9	77	76.9	04.0	37	136.8	07.2	97	196.7	10.3	57	256.6	13.5
18	18.0	00.9	78	77.9	04.1	38	137.8	07.2	98	197.7	10.4	58	257.6	13.5
19	19.0	01.0	79	78.9	04.1	39	138.8	07.3	99	198.7	10.4	59	258.6	13.6
20	20.0	01.0	80	79.9	04.2	40	139.8	07.3	200	199.7	10.5	60	259.6	13.6
21	21.0	01.1	81	80.9	04.2	141	140.8	07.4	201	200.7	10.5	261	260.6	13.7
22	22.0	01.1	82	81.9	04.3	42	141.8	07.4	02	201.7	10.6	62	261.6	13.7
23	23.0	01.2	83	82.9	04.3	43	142.8	07.5	03	202.7	10.6	63	262.6	13.8
24	24.0	01.3	84	83.9	04.4	44	143.8	07.5	04	203.7	10.7	64	263.6	13.8
25	25.0	01.3	85	84.9	04.4	45	144.8	07.6	05	204.7	10.7	65	264.6	13.9
26	26.0	01.4	86	85.9	04.5	46	145.8	07.6	06	205.7	10.8	66	265.6	13.9
27	27.0	01.4	87	86.9	04.6	47	146.8	07.7	07	206.7	10.8	67	266.6	14.0
28	28.0	01.5	88	87.9	04.6	48	147.8	07.7	08	207.7	10.9	68	267.6	14.0
29	29.0	01.5	89	88.9	04.7	49	148.8	07.8	09	208.7	10.9	69	268.6	14.1
30	30.0	01.6	90	89.9	04.7	50	149.8	07.9	10	209.7	11.0	70	269.6	14.1
31	31.0	01.6	91	90.9	04.8	151	150.8	07.9	211	210.7	11.0	271	270.6	14.2
32	32.0	01.7	92	91.9	04.8	52	151.8	08.0	12	211.7	11.1	72	271.6	14.2
33	33.0	01.7	93	92.9	04.9	53	152.8	08.0	13	212.7	11.1	73	272.6	14.3
34	34.0	01.8	94	93.9	04.9	54	153.8	08.1	14	213.7	11.2	74	273.6	14.3
35	35.0	01.8	95	94.9	05.0	55	154.8	08.1	15	214.7	11.3	75	274.6	14.4
36	36.0	01.9	96	95.9	05.0	56	155.8	08.2	16	215.7	11.3	76	275.6	14.4
37	36.9	01.9	97	96.9	05.1	57	156.8	08.2	17	216.7	11.4	77	276.6	14.5
38	37.9	02.0	98	97.9	05.1	58	157.8	08.3	18	217.7	11.4	78	277.6	14.5
39	38.9	02.0	99	98.9	05.2	59	158.8	08.3	19	218.7	11.5	79	278.6	14.6
40	39.9	02.1	100	99.9	05.2	60	159.8	08.4	20	219.7	11.5	80	279.6	14.7
41	40.9	02.1	101	100.9	05.3	161	160.8	08.4	221	220.7	11.6	281	280.6	14.7
42	41.9	02.2	02	101.9	05.3	62	161.8	08.5	22	221.7	11.6	82	281.6	14.8
43	42.9	02.3	03	102.9	05.4	63	162.8	08.5	23	222.7	11.7	83	282.6	14.8
44	43.9	02.3	04	103.9	05.4	64	163.8	08.6	24	223.7	11.7	84	283.6	14.9
45	44.9	02.4	05	104.9	05.5	65	164.8	08.6	25	224.7	11.8	85	284.6	14.9
46	45.9	02.4	06	105.9	05.5	66	165.8	08.7	26	225.7	11.8	86	285.6	15.0
47	46.9	02.5	07	106.9	05.6	67	166.8	08.7	27	226.7	11.9	87	286.6	15.0
48	47.9	02.5	08	107.9	05.7	68	167.8	08.8	28	227.7	11.9	88	287.6	15.1
49	48.9	02.6	09	108.8	05.7	69	168.8	08.8	29	228.7	12.0	89	288.6	15.1
50	49.9	02.6	10	109.8	05.8	70	169.8	08.9	30	229.7	12.0	90	289.6	15.2
51	50.9	02.7	111	110.8	05.8	171	170.8	08.9	231	230.7	12.1	291	290.6	15.2
52	51.9	02.7	12	111.8	05.9	72	171.8	09.0	32	231.7	12.1	92	291.6	15.3
53	52.9	02.8	13	112.8	05.9	73	172.8	09.1	33	232.7	12.2	93	292.6	15.3
54	53.9	02.8	14	113.8	06.0	74	173.8	09.1	34	233.7	12.2	94	293.6	15.4
55	54.9	02.9	15	114.8	06.0	75	174.8	09.2	35	234.7	12.3	95	294.6	15.4
56	55.9	03.9	16	115.8	06.1	76	175.8	09.2	36	235.7	12.4	96	295.6	15.5
57	56.9	03.0	17	116.8	06.1	77	176.8	09.3	37	236.7	12.4	97	296.6	15.5
58	57.9	03.0	18	117.8	06.2	78	177.8	09.3	38	237.7	12.5	98	297.6	15.6
59	58.9	03.1	19	118.8	06.2	79	178.8	09.4	39	238.7	12.5	99	298.6	15.6
60	59.9	03.1	20	119.8	06.3	80	179.8	09.4	40	239.7	12.6	300	299.6	15.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 87 Degrees.

Difference of Latitude and Departure for 10 Degrees.

st.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
61	60.1	10.6	121	119.2	21.0	181	178.3	31.4	241	237.3	41.8
62	61.1	10.8	22	120.1	21.2	82	179.2	31.6	42	238.3	42.0
63	62.0	10.9	23	121.1	21.4	83	180.2	31.8	43	239.3	42.2
64	63.0	11.1	24	122.1	21.5	84	181.2	32.0	44	240.3	42.4
65	64.0	11.2	25	123.1	21.7	85	182.2	32.1	45	241.3	42.5
66	65.0	11.3	26	124.1	21.9	86	183.2	32.3	46	242.3	42.7
67	66.0	11.5	27	125.1	22.0	87	184.2	32.5	47	243.2	42.9
68	67.0	11.8	28	126.1	22.1	88	185.1	32.6	48	244.2	43.1
69	68.0	12.0	29	127.0	22.4	89	186.1	32.8	49	245.2	43.2
70	68.9	12.2	30	128.0	22.6	90	187.1	33.0	50	246.2	43.4
71	69.9	12.3	131	129.0	22.7	191	188.1	33.2	251	247.2	43.5
72	70.9	12.5	32	130.0	22.9	92	189.1	33.3	52	248.2	43.8
73	71.9	12.7	33	131.0	23.1	93	190.1	33.5	53	249.2	43.9
74	72.9	12.8	34	132.0	23.3	94	191.1	33.7	54	250.1	44.1
75	73.9	13.0	35	132.9	23.4	95	192.0	33.9	55	251.1	44.3
76	74.8	13.2	36	133.9	23.6	96	193.0	34.0	56	252.1	44.5
77	75.8	13.4	37	134.9	23.8	97	194.0	34.2	57	253.1	44.6
78	76.8	13.5	38	135.9	24.0	98	195.0	34.4	58	254.1	44.8
79	77.8	13.7	39	136.9	24.1	99	196.0	34.6	59	255.1	45.0
80	78.8	13.9	40	137.9	24.3	200	197.0	34.7	60	256.0	45.1
81	79.8	14.1	141	138.9	24.5	201	197.9	34.9	261	257.0	45.3
82	80.8	14.2	42	139.8	24.7	02	198.9	35.1	62	258.0	45.5
83	81.7	14.4	43	140.8	24.8	03	199.9	35.3	63	259.0	45.7
84	82.7	14.6	44	141.8	25.0	04	200.9	35.4	64	260.0	45.8
85	83.7	14.8	45	142.8	25.2	05	201.9	35.6	65	261.0	46.0
86	84.7	14.9	46	143.8	25.4	06	202.9	35.8	66	262.0	46.2
87	85.7	15.1	47	144.8	25.5	07	203.9	35.9	67	262.9	46.4
88	86.7	15.3	48	145.8	25.7	08	204.8	36.1	68	263.9	46.5
89	87.6	15.5	49	146.7	25.9	09	205.8	36.3	69	264.9	46.7
90	88.6	15.6	50	147.7	26.0	10	206.8	36.5	70	265.9	46.9
91	89.6	15.8	151	148.7	26.2	211	207.8	36.6	271	266.9	47.1
92	90.6	16.0	52	149.7	26.4	12	208.8	36.8	72	267.9	47.2
93	91.6	16.1	53	150.7	26.6	13	209.8	37.0	73	268.9	47.4

TABLE II. Difference of Latitude and Departure for 5 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.1	61	60.8	05.3	121	120.5	10.5	181	180.3	15.8	241	240.1	21.0
2	02.0	00.2	62	61.8	05.4	22	121.5	10.6	82	181.3	15.9	42	241.1	21.1
3	03.0	00.3	63	62.8	05.5	23	122.5	10.7	83	182.3	15.9	43	242.1	21.2
4	04.0	00.3	64	63.8	05.6	24	123.5	10.8	84	183.3	16.0	44	243.1	21.3
5	05.0	00.4	65	64.8	05.7	25	124.5	10.9	85	184.3	16.1	45	244.1	21.4
6	06.0	00.5	66	65.7	05.8	26	125.5	11.0	86	185.3	16.2	46	245.1	21.4
7	07.0	00.6	67	66.7	05.8	27	126.5	11.1	87	186.3	16.3	47	246.1	21.5
8	08.0	00.7	68	67.7	05.9	28	127.5	11.2	88	187.3	16.4	48	247.1	21.6
9	09.0	00.8	69	68.7	06.0	29	128.5	11.2	89	188.3	16.5	49	248.1	21.7
10	10.0	00.9	70	69.7	06.1	30	129.5	11.3	90	189.3	16.6	50	249.1	21.8
11	11.0	01.0	71	70.7	06.2	131	130.5	11.4	191	190.3	16.6	251	250.0	21.9
12	12.0	01.0	72	71.7	06.3	32	131.5	11.5	92	191.3	16.7	52	251.0	22.0
13	13.0	01.1	73	72.7	06.4	33	132.5	11.6	93	192.3	16.8	53	252.0	22.1
14	13.9	01.2	74	73.7	06.4	34	133.5	11.7	94	193.3	16.9	54	253.0	22.1
15	14.9	01.3	75	74.7	06.5	35	134.5	11.8	95	194.3	17.0	55	254.0	22.2
16	15.9	01.4	76	75.7	06.6	36	135.5	11.9	96	195.3	17.1	56	255.0	22.3
17	16.9	01.5	77	76.7	06.7	37	136.5	11.9	97	196.3	17.2	57	256.0	22.4
18	17.9	01.6	78	77.7	06.8	38	137.5	12.0	98	197.2	17.3	58	257.0	22.5
19	18.9	01.7	79	78.7	06.9	39	138.5	12.1	99	198.2	17.3	59	258.0	22.6
20	19.9	01.7	80	79.7	07.0	40	139.5	12.2	200	199.2	17.4	60	259.0	22.7
21	20.9	01.8	81	80.7	07.1	141	140.5	12.3	201	200.2	17.5	261	260.0	22.7
22	21.9	01.9	82	81.7	07.1	42	141.5	12.4	02	201.2	17.6	62	261.0	22.8
23	22.9	02.0	83	82.7	07.2	43	142.5	12.5	03	202.2	17.7	63	262.0	22.9
24	23.9	02.1	84	83.7	07.3	44	143.5	12.6	04	203.2	17.8	64	263.0	23.0
25	24.9	02.2	85	84.7	07.4	45	144.4	12.6	05	204.2	17.9	65	264.0	23.1
26	25.9	02.3	86	85.7	07.5	46	145.4	12.7	06	205.2	18.0	66	265.0	23.2
27	26.9	02.4	87	86.7	07.6	47	146.4	12.8	07	206.2	18.0	67	266.0	23.3
28	27.9	02.4	88	87.7	07.7	48	147.4	12.9	08	207.2	18.1	68	267.0	23.4
29	28.9	02.5	89	88.7	07.8	49	148.4	13.0	09	208.2	18.2	69	268.0	23.4
30	29.9	02.6	90	89.7	07.8	50	149.4	13.1	10	209.2	18.3	70	269.0	23.5
31	30.9	02.7	91	90.7	07.9	151	150.4	13.2	211	210.2	18.4	271	270.0	23.6
32	31.9	02.8	92	91.6	08.0	52	151.4	13.2	12	211.2	18.5	72	271.0	23.7
33	32.9	02.9	93	92.6	08.1	53	152.4	13.3	13	212.2	18.6	73	272.0	23.8
34	33.9	03.0	94	93.6	08.2	54	153.4	13.4	14	213.2	18.7	74	273.0	23.9
35	34.9	03.1	95	94.6	08.3	55	154.4	13.5	15	214.2	18.7	75	274.0	24.0
36	35.9	03.1	96	95.6	08.4	56	155.4	13.6	16	215.2	18.8	76	274.9	24.1
37	36.9	03.2	97	96.6	08.5	57	156.4	13.7	17	216.2	18.9	77	275.9	24.1
38	37.9	03.3	98	97.6	08.5	58	157.4	13.8	18	217.2	19.0	78	276.9	24.2
39	38.9	03.4	99	98.6	08.6	59	158.4	13.9	19	218.2	19.1	79	277.9	24.3
40	39.8	03.5	100	99.6	08.7	60	159.4	13.9	20	219.2	19.2	80	278.9	24.4
41	40.8	03.6	101	100.6	08.8	161	160.4	14.0	221	220.2	19.3	281	279.9	24.5
42	41.8	03.7	02	101.6	08.9	62	161.4	14.1	22	221.2	19.3	82	280.9	24.6
43	42.8	03.7	03	102.6	09.0	63	162.4	14.2	23	222.2	19.4	83	281.9	24.7
44	43.8	03.8	04	103.6	09.1	64	163.4	14.3	24	223.1	19.5	84	282.9	24.8
45	44.8	03.9	05	104.6	09.2	65	164.4	14.4	25	224.1	19.6	85	283.9	24.8
46	45.8	04.0	06	105.6	09.2	66	165.4	14.5	26	225.1	19.7	86	284.8	24.9
47	46.8	04.1	07	106.6	09.3	67	166.4	14.6	27	226.1	19.8	87	285.9	25.0
48	47.8	04.2	08	107.6	09.4	68	167.4	14.6	28	227.1	19.9	88	286.9	25.1
49	48.8	04.3	09	108.6	09.5	69	168.4	14.7	29	228.1	20.0	89	287.9	25.2
50	49.8	04.4	10	109.6	09.6	70	169.4	14.8	30	229.1	20.0	90	288.9	25.3
51	50.8	04.4	111	110.6	09.7	171	170.3	14.9	231	230.1	20.1	291	289.9	25.4
52	51.8	04.5	12	111.6	09.8	72	171.3	15.0	32	231.1	20.2	92	290.9	25.4
53	52.8	04.6	13	112.6	09.8	73	172.3	15.1	33	232.1	20.3	93	291.9	25.5
54	53.8	04.7	14	113.6	09.9	74	173.3	15.2	34	233.1	20.4	94	292.9	25.6
55	54.8	04.8	15	114.6	10.0	75	174.3	15.3	35	234.1	20.5	95	293.9	25.7
56	55.8	04.9	16	115.6	10.1	76	175.3	15.3	36	235.1	20.6	96	294.9	25.8
57	56.8	05.0	17	116.6	10.2	77	176.3	15.4	37	236.1	20.7	97	295.9	25.9
58	57.8	05.1	18	117.6	10.3	78	177.3	15.5	38	237.1	20.7	98	296.9	26.0
59	58.8	05.1	19	118.5	10.4	79	178.3	15.6	39	238.1	20.8	99	297.9	26.1
60	59.8	05.2	20	119.5	10.5	80	179.3	15.7	40	239.1	20.9	300	298.9	26.1
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 85 Degrees.

st.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
61	60.1	10.6	121	119.2	21.0	181	178.3	31.4	241	237.3	41.8
62	61.1	10.8	22	120.1	21.2	82	179.2	31.6	42	238.3	42.0
63	62.0	10.9	23	121.1	21.4	83	180.2	31.8	43	239.3	42.2
64	63.0	11.1	24	122.1	21.5	84	181.2	32.0	44	240.3	42.4
65	64.0	11.2	25	123.1	21.7	85	182.2	32.1	45	241.3	42.5
66	65.0	11.3	26	124.1	21.9	86	183.2	32.3	46	242.3	42.7
67	66.0	11.5	27	125.1	22.0	87	184.2	32.5	47	243.2	42.9
68	67.0	11.8	28	126.1	22.1	88	185.1	32.6	48	244.2	43.1
69	68.0	12.0	29	127.0	22.4	89	186.1	32.8	49	245.2	43.2
70	68.9	12.2	30	128.0	22.6	90	187.1	33.0	50	246.2	43.4
71	69.9	12.3	131	129.0	22.7	191	188.1	33.2	251	247.2	43.5
72	70.9	12.5	32	130.0	22.9	92	189.1	33.3	52	248.2	43.8
73	71.9	12.7	33	131.0	23.1	93	190.1	33.5	53	249.2	43.9
74	72.9	12.8	34	132.0	23.3	94	191.1	33.7	54	250.1	44.1
75	73.9	13.0	35	132.9	23.4	95	192.0	33.9	55	251.1	44.3
76	74.8	13.2	36	133.9	23.6	96	193.0	34.0	56	252.1	44.5
77	75.8	13.4	37	134.9	23.8	97	194.0	34.2	57	253.1	44.6
78	76.8	13.5	38	135.9	24.0	98	195.0	34.4	58	254.1	44.8
79	77.8	13.7	39	136.9	24.1	99	196.0	34.6	59	255.1	45.0
80	78.8	13.9	40	137.9	24.3	200	197.0	34.7	60	256.0	45.1
81	79.8	14.1	141	138.9	24.5	201	197.9	34.9	261	257.0	45.3
82	80.8	14.2	42	139.8	24.7	02	198.9	35.1	62	258.0	45.5
83	81.7	14.4	43	140.8	24.8	03	199.9	35.3	63	259.0	45.7
84	82.7	14.6	44	141.8	25.0	04	200.9	35.4	64	260.0	45.8
85	83.7	14.8	45	142.8	25.2	05	201.9	35.6	65	261.0	46.0
86	84.7	14.9	46	143.8	25.4	06	202.9	35.8	66	262.0	46.2
87	85.7	15.1	47	144.8	25.5	07	203.9	35.9	67	262.9	46.4
88	86.7	15.3	48	145.8	25.7	08	204.8	36.1	68	263.9	46.5
89	87.6	15.5	49	146.7	25.9	09	205.8	36.3	69	264.9	46.7
90	88.6	15.6	50	147.7	26.0	10	206.8	36.5	70	265.9	46.9
91	89.6	15.8	151	148.7	26.2	211	207.8	36.6	271	266.9	47.1
92	90.6	16.0	52	149.7	26.4	12	208.8	36.8	72	267.9	47.2
93	91.6	16.1	53	150.7	26.6	13	209.8	37.0	73	268.9	47.4

TABLE II. Difference of Latitude and Departure for 7 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	00.1	61	60.5	07.4	121	120.1	14.7	181	179.7	22.1	241	239.2	29.4
2	2.0	00.2	62	61.5	07.6	22	121.1	14.9	82	180.6	22.2	42	240.2	29.5
3	3.0	00.4	63	62.5	07.7	23	122.1	15.0	83	181.6	22.3	43	241.2	29.6
4	4.0	00.5	64	63.5	07.8	24	123.1	15.1	84	182.6	22.4	44	242.2	29.7
5	5.0	00.6	65	64.5	07.9	25	124.1	15.2	85	183.6	22.5	45	243.2	29.9
6	6.0	00.7	66	65.5	08.0	26	125.1	15.4	86	184.6	22.7	46	244.2	30.0
7	6.9	00.9	67	66.5	08.2	27	126.1	15.5	87	185.6	22.8	47	245.2	30.1
8	7.9	01.0	68	67.5	08.3	28	127.0	15.6	88	186.6	22.9	48	246.1	30.2
9	8.9	01.1	69	68.5	08.4	29	128.0	15.7	89	187.6	23.0	49	247.1	30.3
10	9.9	01.2	70	69.5	08.5	30	129.0	15.8	90	188.6	23.2	50	248.1	30.5
11	10.9	01.3	71	70.5	08.7	131	130.0	16.0	191	189.6	23.3	251	249.1	30.6
12	11.9	01.5	72	71.5	08.8	32	131.0	16.1	92	190.6	23.4	52	250.1	30.7
13	12.9	01.6	73	72.5	08.9	33	132.0	16.2	93	191.6	23.5	53	251.1	30.8
14	13.9	01.7	74	73.4	09.0	34	133.0	16.3	94	192.6	23.6	54	252.1	31.0
15	14.9	01.8	75	74.4	09.1	35	134.0	16.5	95	193.5	23.8	55	253.1	31.1
16	15.9	01.9	76	75.4	09.3	36	135.0	16.6	96	194.5	23.9	56	254.1	31.2
17	16.9	02.1	77	76.4	09.4	37	136.0	16.7	97	195.5	24.0	57	255.1	31.3
18	17.9	02.2	78	77.4	09.5	38	137.0	16.8	98	196.5	24.1	58	256.1	31.4
19	18.9	02.3	79	78.4	09.6	39	138.0	16.9	99	197.5	24.3	59	257.1	31.6
20	19.9	02.4	80	79.4	09.7	40	139.0	17.1	200	198.5	24.4	60	258.1	31.7
21	20.8	02.6	81	80.4	09.9	141	139.9	17.2	201	199.5	24.5	261	259.1	31.8
22	21.8	02.7	82	81.4	10.0	42	140.9	17.3	02	200.5	24.6	62	260.0	31.9
23	22.8	02.8	83	82.4	10.1	43	141.9	17.4	03	201.5	24.7	63	261.0	32.1
24	23.8	02.9	84	83.4	10.2	44	142.9	17.5	04	202.5	24.9	64	262.0	32.2
25	24.8	03.0	85	84.4	10.4	45	143.9	17.7	05	203.5	25.0	65	263.0	32.3
26	25.8	03.2	86	85.4	10.5	46	144.9	17.8	06	204.5	25.1	66	264.0	32.4
27	26.8	03.3	87	86.3	10.5	47	145.9	17.9	07	205.5	25.2	67	265.0	32.5
28	27.8	03.4	88	87.3	10.7	48	146.9	18.0	08	206.4	25.3	68	266.0	32.7
29	28.8	03.5	89	88.3	10.8	49	147.9	18.2	09	207.4	25.5	69	267.0	32.8
30	29.8	03.7	90	89.3	11.0	50	148.9	18.3	10	208.4	25.6	70	268.0	32.9
31	30.8	03.8	91	90.3	11.1	151	149.9	18.4	211	209.4	25.7	271	269.0	33.0
32	31.8	03.9	92	91.3	11.2	52	150.9	18.5	12	210.4	25.8	72	270.0	33.1
33	32.8	04.0	93	92.3	11.3	53	151.9	18.6	13	211.4	26.0	73	271.0	33.3
34	33.7	04.1	94	93.3	11.5	54	152.9	18.8	14	212.4	26.1	74	272.0	33.4
35	34.7	04.3	95	94.3	11.6	55	153.8	18.9	15	213.4	26.2	75	273.0	33.5
36	35.7	04.4	96	95.3	11.7	56	154.8	19.0	16	214.4	26.3	76	273.9	33.6
37	36.7	04.5	97	96.3	11.8	57	155.8	19.1	17	215.4	26.4	77	274.9	33.8
38	37.7	04.6	98	97.3	11.9	58	156.8	19.3	18	216.4	26.6	78	275.9	33.9
39	38.7	04.8	99	98.3	12.1	59	157.8	19.4	19	217.4	26.7	79	276.9	34.0
40	39.7	04.9	100	99.3	12.2	60	158.8	19.5	20	218.4	26.8	80	277.9	34.1
41	40.7	05.0	101	100.2	12.3	161	159.8	19.6	221	219.4	26.9	281	278.9	34.2
42	41.7	05.1	02	101.2	12.4	62	160.8	19.7	22	220.3	27.1	82	279.9	34.4
43	42.7	05.2	03	102.2	12.6	63	161.8	19.9	23	221.3	27.2	83	280.9	34.5
44	43.7	05.4	04	103.2	12.7	64	162.8	20.0	24	222.3	27.3	84	281.9	34.6
45	44.7	05.5	05	104.2	12.8	65	163.8	20.1	25	223.3	27.4	85	282.9	34.7
46	45.7	05.6	06	105.2	12.9	66	164.8	20.2	26	224.3	27.5	86	283.9	34.9
47	46.6	05.7	07	106.2	13.0	67	165.8	20.4	27	225.3	27.7	87	284.9	35.0
48	47.6	05.8	08	107.2	13.2	68	166.7	20.5	28	226.3	27.8	88	285.9	35.1
49	48.6	06.0	09	108.2	13.3	69	167.7	20.6	29	227.3	27.9	89	286.8	35.2
50	49.6	06.1	10	109.2	13.4	70	168.7	20.7	30	228.3	28.0	90	287.8	35.3
51	50.6	06.2	111	110.2	13.5	171	169.7	20.8	231	229.3	28.2	291	288.8	35.5
52	51.6	06.3	12	111.2	13.6	72	170.7	21.0	32	230.3	28.3	92	289.8	35.6
53	52.6	06.5	13	112.2	13.8	73	171.7	21.1	33	231.3	28.4	93	290.8	35.7
54	53.6	06.6	14	113.2	13.9	74	172.7	21.2	34	232.3	28.5	94	291.8	35.8
55	54.6	06.7	15	114.1	14.0	75	173.7	21.3	35	233.2	28.6	95	292.8	36.0
56	55.6	06.8	16	115.1	14.1	76	174.7	21.4	36	234.2	28.8	96	293.8	36.1
57	56.6	06.9	17	116.1	14.3	77	175.7	21.6	37	235.2	28.9	97	294.8	36.2
58	57.6	07.1	18	117.1	14.4	78	176.7	21.7	38	236.2	29.0	98	295.8	36.3
59	58.6	07.2	19	118.1	14.5	79	177.7	21.8	39	237.2	29.1	99	296.8	36.4
60	59.6	07.3	20	119.1	14.6	80	178.7	21.9	40	238.2	29.2	300	297.8	36.6
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 83 Degrees.

Difference of Latitude and Departure for 12 Degrees.

st.	Lat.	Dep.	Dist.	Lat.	Dep	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
61	59.7	12.7	121	118.4	25.2	181	177.0	37.6	241	235.7	50.1
62	60.6	12.9	22	119.3	25.4	82	178.0	37.8	42	236.7	50.3
63	61.6	13.1	23	120.3	25.6	83	179.0	38.0	43	237.7	50.5
64	62.6	13.3	24	121.3	25.8	84	180.0	38.3	44	238.7	50.7
65	63.6	13.5	25	122.3	26.0	85	181.0	38.5	45	239.6	50.9
66	64.6	13.7	26	123.2	26.2	86	181.9	38.7	46	240.6	51.1
67	65.5	13.9	27	124.2	26.4	87	182.9	38.9	47	241.6	51.4
68	66.5	14.1	28	125.2	26.6	88	183.9	39.1	48	242.6	51.6
69	67.5	14.3	29	126.2	26.8	89	184.9	39.3	49	243.6	51.8
70	68.5	14.6	30	127.2	27.0	90	185.8	39.5	50	244.5	52.0
71	69.4	14.8	131	128.1	27.2	191	186.8	39.7	251	245.5	52.2
72	70.4	15.0	32	129.1	27.4	92	187.8	39.9	52	246.5	52.4
73	71.4	15.2	33	130.1	27.7	93	188.8	40.1	53	247.5	52.6
74	72.4	15.4	34	131.1	27.9	94	189.8	40.3	54	248.4	52.8
75	73.4	15.6	35	132.0	28.1	95	190.7	40.5	55	249.4	53.0
76	74.3	15.8	36	133.0	28.3	96	191.7	40.8	56	250.4	53.2
77	75.3	16.0	37	134.0	28.5	97	192.7	41.0	57	251.4	53.4
78	76.3	16.2	38	135.0	28.7	98	193.7	41.2	58	252.4	53.6
79	77.3	16.4	39	136.0	28.9	99	194.7	41.4	59	253.3	53.8
80	78.3	16.6	40	136.9	29.1	200	195.6	41.6	60	254.3	54.1
81	79.2	16.8	141	137.9	29.3	201	196.6	41.8	261	255.3	54.3
82	80.2	17.0	42	138.9	29.5	02	197.6	42.0	62	256.3	54.5
83	81.2	17.3	43	139.9	29.7	03	198.6	42.2	63	257.2	54.7
84	82.2	17.5	44	140.9	29.9	04	199.5	42.4	64	258.2	54.9
85	83.1	17.7	45	141.8	30.1	05	200.5	42.6	65	259.2	55.1
86	84.1	17.9	46	142.8	30.4	06	201.5	42.8	66	260.2	55.3
87	85.1	18.1	47	143.8	30.6	07	202.5	43.0	67	261.2	55.5
88	86.1	18.3	48	144.8	30.8	08	203.5	43.2	68	262.1	55.7
89	87.0	18.5	49	145.7	31.0	09	204.4	43.5	69	263.1	55.9
90	88.0	18.7	50	146.7	31.2	10	205.4	43.7	70	264.1	56.1
91	89.0	18.9	151	147.7	31.4	211	206.4	43.9	271	265.1	56.3
92	90.0	19.1	52	148.7	31.6	12	207.4	44.1	72	266.1	56.6

TABLE II. Difference of Latitude and Departure for 9 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.2	61	60.2	09.5	121	119.5	18.9	181	178.8	28.3	241	238.0	37.7
2	02.0	00.3	62	61.2	09.7	22	120.5	19.1	82	179.8	28.5	42	239.0	37.9
3	03.0	00.5	63	62.2	09.9	23	121.5	19.2	83	180.7	28.6	43	240.0	38.0
4	04.0	00.6	64	63.2	10.0	24	122.5	19.4	84	181.7	28.8	44	241.0	38.2
5	04.9	00.8	65	64.2	10.2	25	123.5	19.6	85	182.7	28.9	45	242.0	38.3
6	05.9	00.9	66	65.2	10.3	26	124.4	19.7	86	183.7	29.1	46	243.0	38.5
7	06.9	01.1	67	66.2	10.5	27	125.4	19.9	87	184.7	29.3	47	244.0	38.6
8	07.9	01.3	68	67.2	10.6	28	126.4	20.0	88	185.7	29.4	48	244.9	38.8
9	08.9	01.4	69	68.2	10.8	29	127.4	20.2	89	186.7	29.6	49	245.9	39.0
10	09.9	01.6	70	69.1	11.0	30	128.4	20.3	90	187.7	29.7	50	246.9	39.1
11	10.9	01.7	71	70.1	11.1	131	129.4	20.5	191	188.6	29.9	251	247.9	39.3
12	11.9	01.9	72	71.1	11.3	32	130.4	20.6	92	189.6	30.0	52	248.9	39.4
13	12.8	02.0	73	72.1	11.4	33	131.4	20.8	93	190.6	30.2	53	249.9	39.6
14	13.8	02.2	74	73.1	11.6	34	132.4	21.0	94	191.6	30.3	54	250.9	39.7
15	14.8	02.3	75	74.1	11.7	35	133.3	21.1	95	192.6	30.5	55	251.9	39.9
16	15.8	02.5	76	75.1	11.9	36	134.3	21.3	96	193.6	30.7	56	252.8	40.0
17	16.8	02.7	77	76.1	12.0	37	135.3	21.4	97	194.6	30.8	57	253.8	40.2
18	17.8	02.8	78	77.0	12.2	38	136.3	21.6	98	195.6	31.0	58	254.8	40.4
19	18.8	03.0	79	78.0	12.4	39	137.3	21.7	99	196.5	31.1	59	255.8	40.5
20	19.8	03.1	80	79.0	12.5	40	138.3	21.9	200	197.5	31.3	60	256.8	40.7
21	20.7	03.3	81	80.0	12.7	141	139.3	22.1	201	198.5	31.4	261	257.8	40.8
22	21.7	03.4	82	81.0	12.8	42	140.3	22.2	02	199.5	31.6	62	258.8	41.0
23	22.7	03.6	83	82.0	13.0	43	141.2	22.4	03	200.5	31.8	63	259.8	41.1
24	23.7	03.8	84	83.0	13.1	44	142.2	22.5	04	201.5	31.9	64	260.7	41.3
25	24.7	03.9	85	84.0	13.3	45	143.2	22.7	05	202.5	32.1	65	261.7	41.5
26	25.7	04.1	86	84.9	13.5	46	144.2	22.8	06	203.5	32.2	66	262.7	41.6
27	26.7	04.2	87	85.9	13.6	47	145.2	23.0	07	204.5	32.4	67	263.7	41.8
28	27.7	04.4	88	86.9	13.8	48	146.2	23.2	08	205.4	32.5	68	264.7	41.9
29	28.6	04.5	89	87.9	13.9	49	147.2	23.3	09	206.4	32.7	69	265.7	42.1
30	29.6	04.7	90	88.9	14.1	50	148.2	23.5	10	207.4	32.9	70	266.7	42.2
31	30.6	04.8	91	89.9	14.2	151	149.1	23.6	211	208.4	33.0	271	267.7	42.4
32	31.6	05.0	92	90.9	14.4	52	150.1	23.8	12	209.4	33.2	72	268.7	42.6
33	32.6	05.2	93	91.9	14.5	53	151.1	23.9	13	210.4	33.3	73	269.6	42.7
34	33.6	05.3	94	92.8	14.7	54	152.1	24.1	14	211.4	33.5	74	270.6	42.9
35	34.6	05.5	95	93.8	14.9	55	153.1	24.2	15	212.4	33.6	75	271.6	43.0
36	35.6	05.6	96	94.8	15.0	56	154.1	24.4	16	213.3	33.8	76	272.6	43.2
37	36.5	05.8	97	95.8	15.2	57	155.1	24.6	17	214.3	33.9	77	273.6	43.3
38	37.5	05.9	98	96.8	15.3	58	156.1	24.7	18	215.3	34.1	78	274.6	43.5
39	38.5	06.1	99	97.8	15.5	59	157.0	24.9	19	216.3	34.3	79	275.6	43.6
40	39.5	06.3	100	98.8	15.6	60	158.0	25.0	20	217.3	34.4	80	276.6	43.8
41	40.5	06.4	101	99.8	15.8	161	159.0	25.2	221	218.3	34.6	281	277.5	44.0
42	41.5	06.6	02	100.7	16.0	62	160.0	25.3	22	219.3	34.7	82	278.5	44.1
43	42.5	06.7	03	101.7	16.1	63	161.0	25.5	23	220.3	34.9	83	279.5	44.3
44	43.5	06.9	04	102.7	16.3	64	162.0	25.7	24	221.2	35.0	84	280.5	44.4
45	44.4	07.0	05	103.7	16.4	65	163.0	25.8	25	222.2	35.2	85	281.5	44.6
46	45.4	07.2	06	104.7	16.6	66	164.0	26.0	26	223.2	35.4	86	282.5	44.7
47	46.4	07.4	07	105.7	16.7	67	164.9	26.1	27	224.2	35.5	87	283.5	44.9
48	47.4	07.5	08	106.7	16.9	68	165.9	26.3	28	225.2	35.7	88	284.5	45.1
49	48.4	07.7	09	107.7	17.1	69	166.9	26.4	29	226.2	35.8	89	285.4	45.2
50	49.4	07.8	10	108.6	17.2	70	167.9	26.6	30	227.2	36.0	90	286.4	45.4
51	50.4	08.0	111	109.6	17.4	171	168.9	26.8	231	228.2	36.1	291	287.4	45.5
52	51.4	08.1	12	110.6	17.5	72	169.9	26.9	32	229.1	36.3	92	288.4	45.7
53	52.3	08.3	13	111.6	17.7	73	170.9	27.1	33	230.1	36.4	93	289.4	45.8
54	53.3	08.4	14	112.6	17.8	74	171.9	27.2	34	231.1	36.6	94	290.4	46.0
55	54.3	08.6	15	113.6	18.0	75	172.8	27.4	35	232.1	36.8	95	291.4	46.1
56	55.3	08.8	16	114.6	18.1	76	173.8	27.5	36	233.1	36.9	96	292.4	46.3
57	56.3	08.9	17	115.6	18.3	77	174.8	27.7	37	234.1	37.1	97	293.3	46.5
58	57.3	09.1	18	116.5	18.5	78	175.8	27.8	38	235.1	37.2	98	294.3	46.6
59	58.3	09.2	19	117.5	18.6	79	176.8	28.0	39	236.1	37.4	99	295.3	46.8
60	59.3	09.4	20	118.5	18.8	80	177.8	28.2	40	237.0	37.5	300	296.3	46.9
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 81 Degrees.

Difference of Latitude and Departure for 12 Degrees.

st.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
61	59.7	12.7	121	118.4	25.2	181	177.0	37.6	241	235.7	50.1
62	60.6	12.9	22	119.3	25.4	82	178.0	37.8	42	236.7	50.3
63	61.6	13.1	23	120.3	25.6	83	179.0	38.0	43	237.7	50.5
64	62.6	13.3	24	121.3	25.8	84	180.0	38.3	44	238.7	50.7
65	63.6	13.5	25	122.3	26.0	85	181.0	38.5	45	239.6	50.9
66	64.6	13.7	26	123.2	26.2	86	181.9	38.7	46	240.6	51.1
67	65.5	13.9	27	124.2	26.4	87	182.9	38.9	47	241.6	51.4
68	66.5	14.1	28	125.2	26.6	88	183.9	39.1	48	242.6	51.6
69	67.5	14.3	29	126.2	26.8	89	184.9	39.3	49	243.6	51.8
70	68.5	14.6	30	127.2	27.0	90	185.8	39.5	50	244.5	52.0
71	69.4	14.8	131	128.1	27.2	191	186.8	39.7	251	245.5	52.2
72	70.4	15.0	32	129.1	27.4	92	187.8	39.9	52	246.5	52.4
73	71.4	15.2	33	130.1	27.7	93	188.8	40.1	53	247.5	52.6
74	72.4	15.4	34	131.1	27.9	94	189.8	40.3	54	248.4	52.8
75	73.4	15.6	35	132.0	28.1	95	190.7	40.5	55	249.4	53.0
76	74.3	15.8	36	133.0	28.3	96	191.7	40.8	56	250.4	53.2
77	75.3	16.0	37	134.0	28.5	97	192.7	41.0	57	251.4	53.4
78	76.3	16.2	38	135.0	28.7	98	193.7	41.2	58	252.4	53.6
79	77.3	16.4	39	136.0	28.9	99	194.7	41.4	59	253.3	53.8
80	78.3	16.6	40	136.9	29.1	200	195.6	41.6	60	254.3	54.1
81	79.2	16.8	141	137.9	29.3	201	196.6	41.8	261	255.3	54.3
82	80.2	17.0	42	138.9	29.5	02	197.6	42.0	62	256.3	54.5
83	81.2	17.3	43	139.9	29.7	03	198.6	42.2	63	257.2	54.7
84	82.2	17.5	44	140.9	29.9	04	199.5	42.4	64	258.2	54.9
85	83.1	17.7	45	141.8	30.1	05	200.5	42.6	65	259.2	55.1
86	84.1	17.9	46	142.8	30.4	06	201.5	42.8	66	260.2	55.3
87	85.1	18.1	47	143.8	30.6	07	202.5	43.0	67	261.2	55.5
88	86.1	18.3	48	144.8	30.8	08	203.5	43.2	68	262.1	55.7
89	87.0	18.5	49	145.7	31.0	69	204.4	43.5	69	263.1	55.9
90	88.0	18.7	50	146.7	31.2	10	205.4	43.7	70	264.1	55.1
91	89.0	18.9	151	147.7	31.4	211	206.4	43.9	271	265.1	56.3
92	90.0	19.1	52	148.7	31.6	12	207.4	44.1	72	266.1	56.6

TABLE II. Difference of Latitude and Departure for 11 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.2	61	59.9	11.6	121	118.8	23.1	181	177.7	34.5	241	236.6	46.0
2	02.0	00.4	62	60.9	11.8	22	119.8	23.3	82	178.7	34.7	42	237.6	46.2
3	02.9	00.6	63	61.8	12.0	23	120.7	23.5	83	179.6	34.9	43	238.5	46.4
4	03.9	00.8	64	62.8	12.2	24	121.7	23.7	84	180.6	35.1	44	239.5	46.6
5	04.9	01.0	65	63.8	12.4	25	122.7	23.9	85	181.6	35.3	45	240.5	46.7
6	05.9	01.1	66	64.8	12.6	26	123.7	24.0	86	182.6	35.5	46	241.5	46.9
7	06.9	01.3	67	65.8	12.8	27	124.7	24.2	87	183.6	35.7	47	242.5	47.1
8	07.9	01.5	68	66.8	13.0	28	125.6	24.4	88	184.5	35.9	48	243.4	47.3
9	08.8	01.7	69	67.7	13.2	29	126.6	24.6	89	185.5	36.1	49	244.4	47.5
10	09.8	01.9	70	68.7	13.4	30	127.6	24.8	90	186.5	36.3	50	245.4	47.7
11	10.8	02.1	71	69.7	13.5	131	128.6	25.0	191	187.5	36.4	251	246.4	47.9
12	11.8	02.3	72	70.7	13.7	32	129.6	25.2	92	188.5	36.6	52	247.4	48.1
13	12.8	02.5	73	71.7	13.9	33	130.6	25.4	93	189.5	36.8	53	248.4	48.3
14	13.7	02.7	74	72.6	14.1	34	131.5	25.6	94	190.4	37.0	54	249.3	48.5
15	14.7	02.9	75	73.6	14.3	35	132.5	25.8	95	191.4	37.2	55	250.3	48.7
16	15.7	03.1	76	74.6	14.5	36	133.5	26.0	96	192.4	37.4	56	251.3	48.8
17	16.7	03.2	77	75.6	14.7	37	134.5	26.1	97	193.4	37.6	57	252.3	49.0
18	17.7	03.4	78	76.6	14.9	38	135.5	26.3	98	194.4	37.8	58	253.3	49.2
19	18.7	03.6	79	77.5	15.1	39	136.4	26.5	99	195.3	38.0	59	254.2	49.4
20	19.6	03.8	80	78.5	15.3	40	137.4	26.7	200	196.3	38.2	60	255.2	49.6
21	20.6	04.0	81	79.5	15.5	141	138.4	26.9	201	197.3	38.4	261	256.2	49.8
22	21.6	04.2	82	80.5	15.6	42	139.4	27.1	02	198.3	38.5	62	257.2	50.0
23	22.6	04.4	83	81.5	15.8	43	140.4	27.3	03	199.3	38.7	63	258.2	50.2
24	23.6	04.6	84	82.5	16.0	44	141.4	27.5	04	200.3	38.9	64	259.1	50.4
25	24.5	04.8	85	83.4	16.2	45	142.3	27.7	05	201.2	39.1	65	260.1	50.6
26	25.5	05.0	86	84.4	16.4	46	143.3	27.9	06	202.2	39.3	66	261.1	50.8
27	26.5	05.2	87	85.4	16.6	47	144.3	28.0	07	203.2	39.5	67	262.1	50.9
28	27.5	05.3	88	86.4	16.8	48	145.3	28.2	08	204.2	39.7	68	263.1	51.1
29	28.5	05.5	89	87.4	17.0	49	146.3	28.4	09	205.2	39.9	69	264.1	51.3
30	29.4	05.7	90	88.3	17.2	50	147.2	28.6	10	206.1	40.1	70	265.0	51.5
31	30.4	05.9	91	89.3	17.4	151	148.2	28.8	211	207.1	40.3	271	266.0	51.7
32	31.4	06.1	92	90.3	17.6	52	149.2	29.0	12	208.1	40.4	72	267.0	51.9
33	32.4	06.3	93	91.3	17.7	53	150.2	29.2	13	209.1	40.5	73	268.0	52.1
34	33.4	06.5	94	92.3	17.9	54	151.2	29.4	14	210.1	40.8	74	269.0	52.3
35	34.4	06.7	95	93.3	18.1	55	152.2	29.6	15	211.0	41.0	75	269.9	52.5
36	35.3	06.9	96	94.2	18.3	56	153.1	29.8	16	212.0	41.2	76	270.9	52.7
37	36.3	07.1	97	95.2	18.5	57	154.1	30.0	17	213.0	41.4	77	271.9	52.9
38	37.3	07.3	98	96.2	18.7	58	155.1	30.1	18	214.0	41.6	78	272.9	53.0
39	38.3	07.4	99	97.2	18.9	59	156.1	30.3	19	215.0	41.8	79	273.9	53.2
40	39.3	07.6	100	98.2	19.1	60	157.1	30.5	20	216.0	42.0	80	274.8	53.4
41	40.2	07.8	101	99.1	19.3	161	158.0	30.7	221	216.9	42.2	281	275.8	53.6
42	41.2	08.0	02	100.1	19.5	62	159.0	30.9	22	217.9	42.4	82	276.8	53.8
43	42.2	08.2	03	101.1	19.7	63	160.0	31.1	23	218.9	42.6	83	277.8	54.0
44	43.2	08.4	04	102.1	19.8	64	161.0	31.3	24	219.9	42.7	84	278.8	54.2
45	44.2	08.6	05	103.1	20.0	65	162.0	31.5	25	220.9	42.9	85	279.8	54.4
46	45.2	08.8	06	104.1	20.2	66	163.0	31.7	26	221.8	43.1	86	280.7	54.6
47	46.1	09.0	07	105.0	20.4	67	163.9	31.9	27	222.8	43.3	87	281.7	54.8
48	47.1	09.2	08	106.0	20.6	68	164.9	32.1	28	223.8	43.5	88	282.7	55.0
49	48.1	09.3	09	107.0	20.8	69	165.9	32.2	29	224.8	43.7	89	283.7	55.1
50	49.1	09.5	10	108.0	21.0	70	166.9	32.4	30	225.8	43.9	90	284.7	55.3
51	50.1	09.7	111	109.0	21.2	171	167.9	32.6	231	226.8	44.1	291	285.7	55.5
52	51.0	09.9	12	109.9	21.4	72	168.8	32.8	32	227.7	44.3	92	286.6	55.7
53	52.0	10.1	13	110.9	21.6	73	169.8	33.0	33	228.7	44.5	93	287.6	55.9
54	53.0	10.3	14	111.9	21.8	74	170.8	33.2	34	229.7	44.6	94	288.6	56.1
55	54.0	10.5	15	112.9	21.9	75	171.8	33.4	35	230.7	44.8	95	289.6	56.3
56	55.0	10.7	16	113.9	22.1	76	172.8	33.6	36	231.7	45.0	96	290.6	56.5
57	56.0	10.9	17	114.9	22.3	77	173.7	33.8	37	232.6	45.2	97	291.5	56.7
58	56.9	11.1	18	115.8	22.5	78	174.7	34.0	38	233.6	45.4	98	292.5	56.9
59	57.9	11.3	19	116.8	22.7	79	175.7	34.2	39	234.6	45.6	99	293.5	57.1
60	58.9	11.4	20	117.8	22.9	80	176.7	34.3	40	235.6	45.8	300	294.5	57.2
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 79 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
61	59.2	14.8	121	117.4	29.3	181	175.6	43.8	241	233.8	58.3
62	60.2	15.0	22	118.4	29.5	82	176.6	44.0	42	234.8	58.5
63	61.1	15.2	23	119.3	29.8	83	177.6	44.3	43	235.8	58.8
64	62.1	15.5	24	120.3	30.0	84	178.5	44.5	44	236.8	59.0
65	63.1	15.7	25	121.3	30.2	85	179.5	44.8	45	237.7	59.3
66	64.0	16.0	26	122.3	30.5	86	180.5	45.0	46	238.7	59.5
67	65.0	16.2	27	123.2	30.7	87	181.4	45.2	47	239.7	59.8
68	66.0	16.5	28	124.2	31.0	88	182.4	45.5	48	240.6	60.0
69	67.0	16.7	29	125.2	31.2	89	183.4	45.7	49	241.6	60.2
70	67.9	16.9	30	126.1	31.4	90	184.4	46.0	50	242.6	60.5
71	68.9	17.2	131	127.1	31.7	191	185.3	46.2	251	243.5	60.7
72	69.9	17.4	32	128.1	31.9	92	186.3	46.4	52	244.5	61.0
73	70.8	17.7	33	129.0	32.2	93	187.3	46.7	53	245.5	61.2
74	71.8	17.9	34	130.0	32.4	94	188.2	46.9	54	246.5	61.4
75	72.8	18.1	35	131.0	32.7	95	189.2	47.2	55	247.4	61.7
76	73.7	18.4	36	132.0	32.9	96	190.2	47.4	56	248.4	61.9
77	74.7	18.6	37	132.9	33.1	97	191.1	47.7	57	249.4	62.2
78	75.7	18.9	38	133.9	33.4	98	192.1	47.9	58	250.3	62.4
79	76.7	19.1	39	134.9	33.6	99	193.1	48.1	59	251.3	62.7
80	77.6	19.4	40	135.8	33.9	200	194.1	48.4	60	252.3	62.9
81	78.6	19.6	141	136.8	34.1	201	195.0	48.6	261	253.2	63.1
82	79.6	19.8	42	137.8	34.4	02	196.0	48.9	62	254.2	63.4
83	80.5	20.1	43	138.8	34.6	03	197.0	49.1	63	255.2	63.6
84	81.5	20.3	44	139.7	34.8	04	197.9	49.4	64	256.2	63.9
85	82.5	20.6	45	140.7	35.1	05	198.9	49.6	65	257.1	64.1
86	83.4	20.8	46	141.7	35.3	06	199.9	49.8	66	258.1	64.4
87	84.4	21.0	47	142.6	35.6	07	200.9	50.1	67	259.1	64.6
88	85.4	21.3	48	143.6	35.8	08	201.8	50.3	68	260.0	64.8
89	86.4	21.5	49	144.6	36.0	09	202.8	50.6	69	261.0	65.1
90	87.3	21.8	50	145.5	36.3	10	203.8	50.8	70	262.0	65.3
91	88.3	22.0	151	146.5	36.5	211	204.7	51.0	271	263.0	65.6
92	89.3	22.3	52	147.5	36.8	12	205.7	51.3	72	263.9	65.8

TABLE II. Difference of Latitude and Departure for 13 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.2	61	59.4	13.7	121	117.9	27.2	181	176.4	40.7	241	234.8	54.2
2	01.9	00.4	62	60.4	13.9	22	118.9	27.4	82	177.3	40.9	42	235.8	54.4
3	02.9	00.7	63	61.4	14.2	23	119.8	27.7	83	178.3	41.2	43	236.8	54.7
4	03.9	00.9	64	62.4	14.4	24	120.8	27.9	84	179.3	41.4	44	237.7	54.9
5	04.9	01.1	65	63.3	14.6	25	121.8	28.1	85	180.3	41.6	45	238.7	55.1
6	05.8	01.3	66	64.3	14.8	26	122.8	28.3	86	181.2	41.8	46	239.7	55.3
7	06.8	01.6	67	65.3	15.1	27	123.7	28.6	87	182.2	42.1	47	240.7	55.6
8	07.8	01.8	68	66.3	15.3	28	124.7	28.8	88	183.2	42.3	48	241.6	55.8
9	08.8	02.0	69	67.2	15.5	29	125.7	29.0	89	184.2	42.5	49	242.6	56.0
10	09.7	02.2	70	68.2	15.7	30	126.7	29.2	90	185.1	42.7	50	243.6	56.2
11	10.7	02.5	71	69.2	16.0	131	127.6	29.5	191	186.1	43.0	251	244.6	56.5
12	11.7	02.7	72	70.2	16.2	32	128.6	29.7	92	187.1	43.2	52	245.5	56.7
13	12.7	02.9	73	71.1	16.4	33	129.6	29.9	93	188.1	43.4	53	246.5	56.9
14	13.6	03.1	74	72.1	16.6	34	130.6	30.1	94	189.0	43.6	54	247.5	57.1
15	14.6	03.4	75	73.1	16.9	35	131.5	30.4	95	190.0	43.9	55	248.5	57.4
16	15.6	03.6	76	74.1	17.1	36	132.5	30.6	96	191.0	44.1	56	249.4	57.6
17	16.6	03.8	77	75.0	17.3	37	133.5	30.8	97	192.0	44.3	57	250.4	57.8
18	17.5	04.0	78	76.0	17.5	38	134.5	31.0	98	192.9	44.5	58	251.4	58.0
19	18.5	04.3	79	77.0	17.8	39	135.4	31.3	99	193.9	44.8	59	252.4	58.3
20	19.5	04.5	80	78.0	18.0	40	136.4	31.5	200	194.9	45.0	60	253.3	58.5
21	20.5	04.7	81	78.9	18.2	141	137.4	31.7	201	195.8	45.2	261	254.3	58.7
22	21.4	04.9	82	79.9	18.4	42	138.4	31.9	02	196.8	45.4	62	255.3	58.9
23	22.4	05.2	83	80.9	18.7	43	139.3	32.2	03	197.8	45.7	63	256.3	59.2
24	23.4	05.4	84	81.8	18.9	44	140.3	32.4	04	198.8	45.9	64	257.2	59.4
25	24.4	05.6	85	82.8	19.1	45	141.3	32.6	05	199.7	46.1	65	258.2	59.6
26	25.3	05.8	86	83.8	19.3	46	142.3	32.8	06	200.7	46.3	66	259.2	59.8
27	26.3	06.1	87	84.8	19.6	47	143.2	33.1	07	201.7	46.6	67	260.2	60.1
28	27.3	06.3	88	85.7	19.8	48	144.2	33.3	08	202.7	46.8	68	261.1	60.3
29	28.3	06.5	89	86.7	20.0	49	145.2	33.5	09	203.6	47.0	69	262.1	60.5
30	29.2	06.7	90	87.7	20.2	50	146.2	33.7	10	204.6	47.2	70	263.1	60.7
31	30.2	07.0	91	88.7	20.5	151	147.1	34.0	211	205.6	47.5	271	264.1	61.0
32	31.2	07.2	92	89.6	20.7	52	148.1	34.2	12	206.6	47.7	72	265.0	61.2
33	32.2	07.4	93	90.6	20.9	53	149.1	34.4	13	207.5	47.9	73	266.0	61.4
34	33.1	07.6	94	91.6	21.1	54	150.1	34.6	14	208.5	48.1	74	267.0	61.6
35	34.1	07.9	95	92.6	21.4	55	151.0	34.9	15	209.5	48.4	75	268.0	61.9
36	35.1	08.1	96	93.5	21.6	56	152.0	35.1	16	210.5	48.6	76	268.9	62.1
37	36.1	08.3	97	94.5	21.8	57	153.0	35.3	17	211.4	48.8	77	269.9	62.3
38	37.0	08.5	98	95.5	22.0	58	154.0	35.5	18	212.4	49.0	78	270.9	62.5
39	38.0	08.8	99	96.5	22.3	59	154.9	35.8	19	213.4	49.3	79	271.9	62.8
40	39.0	09.0	100	97.4	22.5	60	155.9	36.0	20	214.4	49.5	80	272.8	63.0
41	39.9	09.2	101	98.4	22.7	161	156.9	36.2	221	215.3	49.7	281	273.8	63.2
42	40.9	09.4	02	99.4	22.9	62	157.8	36.4	22	216.3	49.9	82	274.8	63.4
43	41.9	09.7	03	100.4	23.2	63	158.8	36.7	23	217.3	50.2	83	275.7	63.7
44	42.9	09.9	04	101.3	23.4	64	159.8	36.9	24	218.3	50.4	84	276.7	63.9
45	43.8	10.1	05	102.3	23.6	65	160.8	37.1	25	219.2	50.6	85	277.7	64.1
46	44.8	10.3	06	103.3	23.8	66	161.7	37.3	26	220.2	50.8	86	278.7	64.3
47	45.8	10.6	07	104.3	24.1	67	162.7	37.6	27	221.2	51.1	87	279.6	64.6
48	46.8	10.8	08	105.2	24.3	68	163.7	37.8	28	222.2	51.3	88	280.6	64.8
49	47.7	11.0	09	106.2	24.5	69	164.7	38.0	29	223.1	51.5	89	281.6	65.0
50	48.7	11.2	10	107.2	24.7	70	165.6	38.2	30	224.1	51.7	90	282.6	65.2
51	49.7	11.5	111	108.2	25.0	171	166.6	38.5	231	225.1	52.0	291	283.5	65.5
52	50.7	11.7	12	109.1	25.2	72	167.6	38.7	32	226.1	52.2	92	284.5	65.7
53	51.6	11.9	13	110.1	25.4	73	168.6	38.9	33	227.0	52.4	93	285.5	65.9
54	52.6	12.1	14	111.1	25.6	74	169.5	39.1	34	228.0	52.6	94	286.5	66.1
55	53.6	12.4	15	112.1	25.9	75	170.5	39.4	35	229.0	52.9	95	287.4	66.4
56	54.6	12.6	16	113.0	26.1	76	171.5	39.6	36	230.0	53.1	96	288.4	66.6
57	55.5	12.8	17	114.0	26.3	77	172.5	39.8	37	230.9	53.3	97	289.4	66.8
58	56.5	13.0	18	115.0	26.5	78	173.4	40.0	38	231.9	53.5	98	290.4	67.0
59	57.5	13.3	19	116.0	26.8	79	174.4	40.3	39	232.9	53.8	99	291.3	67.3
60	58.5	13.5	20	116.9	27.0	80	175.4	40.5	40	233.8	54.0	300	292.3	67.5
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 77 Degrees.

TABLE II. Difference of Latitude and Departure for 16 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.3	61	58.6	16.8	121	116.3	33.4	181	174.0	49.9	241	231.7	66.4
2	01.9	00.6	62	59.6	17.1	22	117.3	33.6	82	174.9	50.2	42	232.6	66.7
3	02.9	00.8	63	60.6	17.4	23	118.2	33.9	83	175.9	50.4	43	233.6	67.0
4	03.8	01.1	64	61.5	17.6	24	119.2	34.2	84	176.9	50.7	44	234.5	67.3
5	04.8	01.4	65	62.5	17.9	25	120.2	34.5	85	177.8	51.0	45	235.5	67.5
6	05.8	01.7	66	63.4	18.2	26	121.1	34.7	86	178.8	51.3	46	236.5	67.8
7	06.7	01.9	67	64.4	18.5	27	122.1	35.0	87	179.8	51.5	47	237.4	68.1
8	07.7	02.2	68	65.4	18.7	28	123.0	35.3	88	180.7	51.8	48	238.4	68.4
9	08.7	02.5	69	66.3	19.0	29	124.0	35.6	89	181.7	52.1	49	239.4	68.6
10	09.6	02.8	70	67.3	19.3	30	125.0	35.8	90	182.6	52.4	50	240.3	68.9
11	10.6	03.0	71	68.2	19.6	131	125.9	36.1	191	183.6	52.6	251	241.3	69.2
12	11.5	03.3	72	69.2	19.8	32	126.9	36.4	92	184.6	52.9	52	242.2	69.5
13	12.5	03.6	73	70.2	20.1	33	127.8	36.7	93	185.5	53.2	53	243.2	69.7
14	13.5	03.9	74	71.1	20.4	34	128.8	36.9	94	186.5	53.5	54	244.2	70.0
15	14.4	04.1	75	72.1	20.7	35	129.8	37.2	95	187.4	53.7	55	245.1	70.3
16	15.4	04.4	76	73.1	20.9	36	130.7	37.5	96	188.4	54.0	56	246.1	70.6
17	16.3	04.7	77	74.0	21.2	37	131.7	37.8	97	189.4	54.3	57	247.0	70.8
18	17.3	05.0	78	75.0	21.5	38	132.7	38.0	98	190.3	54.6	58	248.0	71.1
19	18.3	05.2	79	75.9	21.8	39	133.6	38.3	99	191.3	54.9	59	249.0	71.4
20	19.2	05.5	80	76.9	22.1	40	134.6	38.6	200	192.3	55.1	60	249.9	71.7
21	20.2	05.8	81	77.9	22.3	141	135.5	38.9	201	193.2	55.4	261	250.9	71.9
22	21.1	06.1	82	78.8	22.6	42	136.5	39.1	02	194.2	55.7	62	251.9	72.2
23	22.1	06.3	83	79.8	22.9	43	137.5	39.4	03	195.1	56.0	63	252.8	72.5
24	23.1	06.6	84	80.7	23.2	44	138.4	39.7	04	196.1	56.2	64	253.8	72.8
25	24.0	06.9	85	81.7	23.4	45	139.4	40.0	05	197.1	56.5	65	254.7	73.0
26	25.0	07.2	86	82.7	23.7	46	140.3	40.2	06	198.0	56.8	66	255.7	73.3
27	26.0	07.4	87	83.6	24.0	47	141.3	40.5	07	199.0	57.1	67	256.7	73.6
28	26.9	07.7	88	84.6	24.3	48	142.3	40.8	08	199.9	57.3	68	257.6	73.9
29	27.9	08.0	89	85.6	24.5	49	143.2	41.1	09	200.9	57.6	69	258.6	74.1
30	28.8	08.3	90	86.5	24.8	50	144.2	41.3	10	201.9	57.9	70	259.5	74.4
31	29.8	08.5	91	87.5	25.1	151	145.2	41.6	211	202.8	58.2	271	260.5	74.7
32	30.8	08.8	92	88.4	25.4	52	146.1	41.9	12	203.8	58.4	72	261.5	75.0
33	31.7	09.1	93	89.4	25.6	53	147.1	42.2	13	204.7	58.7	73	262.4	75.2
34	32.7	09.4	94	90.4	25.9	54	148.0	42.4	14	205.7	59.0	74	263.4	75.5
35	33.6	09.6	95	91.3	26.2	55	149.0	42.7	15	206.7	59.3	75	264.3	75.8
36	34.6	09.9	96	92.3	26.5	56	150.0	43.0	16	207.6	59.5	76	265.3	76.1
37	35.6	10.2	97	93.2	26.7	57	150.9	43.3	17	208.6	59.8	77	266.3	76.4
38	36.5	10.5	98	94.2	27.0	58	151.9	43.6	18	209.6	60.1	78	267.2	76.6
39	37.5	10.7	99	95.2	27.3	59	152.8	43.8	19	210.5	60.4	79	268.2	76.9
40	38.5	11.0	100	96.1	27.6	60	153.8	44.1	20	211.5	60.6	80	269.2	77.2
41	39.4	11.3	101	97.1	27.8	161	154.8	44.4	221	212.4	60.9	281	270.1	77.5
42	40.4	11.6	02	98.0	28.1	62	155.7	44.7	22	213.4	61.2	82	271.1	77.7
43	41.3	11.9	03	99.0	28.4	63	156.7	44.9	23	214.4	61.5	83	272.0	78.0
44	42.3	12.1	04	100.0	28.7	64	157.6	45.2	24	215.3	61.7	84	273.0	78.3
45	43.3	12.4	05	100.9	28.9	65	158.6	45.5	25	216.3	62.0	85	274.0	78.6
46	44.2	12.7	06	101.9	29.2	66	159.6	45.8	26	217.2	62.3	86	274.9	78.8
47	45.2	13.0	07	102.9	29.5	67	160.5	46.0	27	218.2	62.6	87	275.9	79.1
48	46.1	13.2	08	103.8	29.8	68	161.5	46.3	28	219.2	62.8	88	276.8	79.4
49	47.1	13.5	09	104.8	30.0	69	162.5	46.6	29	220.1	63.1	89	277.8	79.7
50	48.1	13.8	10	105.7	30.3	70	163.4	46.9	30	221.1	63.4	90	278.8	79.9
51	49.0	14.1	111	106.7	30.6	171	164.4	47.1	231	222.1	63.7	291	279.7	80.2
52	50.0	14.3	12	107.7	30.9	72	165.3	47.4	32	223.0	63.9	92	280.7	80.5
53	50.9	14.6	13	108.6	31.1	73	166.3	47.7	33	224.0	64.2	93	281.6	80.8
54	51.9	14.9	14	109.6	31.4	74	167.3	48.0	34	224.9	64.5	94	282.6	81.0
55	52.9	15.2	15	110.5	31.7	75	168.2	48.2	35	225.9	64.8	95	283.6	81.3
56	53.8	15.4	16	111.5	32.0	76	169.2	48.5	36	226.9	65.1	96	284.5	81.6
57	54.8	15.7	17	112.5	32.2	77	170.1	48.8	37	227.8	65.3	97	285.5	81.9
58	55.8	16.0	18	113.4	32.5	78	171.1	49.1	38	228.8	65.6	98	286.5	82.1
59	56.7	16.3	19	114.4	32.8	79	172.1	49.3	39	229.7	65.9	99	287.4	82.4
60	57.7	16.5	20	115.4	33.1	80	173.0	49.6	40	230.7	66.2	300	288.4	82.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 74 Degrees.

TABLE II. Difference of Latitude and Departure for 15 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.3	61	58.9	15.8	121	116.9	31.3	181	174.8	46.8	241	232.8	62.4
2	01.9	00.5	62	59.9	16.0	22	117.8	31.6	82	175.8	47.1	42	233.8	62.6
3	02.9	00.8	63	60.9	16.3	23	118.8	31.8	83	176.8	47.4	43	234.7	62.9
4	03.9	01.0	64	61.8	16.6	24	119.8	32.1	84	177.7	47.6	44	235.7	63.2
5	04.8	01.3	65	62.8	16.8	25	120.7	32.4	85	178.7	47.9	45	236.7	63.4
6	05.8	01.6	66	63.8	17.1	26	121.7	32.6	86	179.7	48.1	46	237.6	63.7
7	06.8	01.8	67	64.7	17.3	27	122.7	32.9	87	180.6	48.4	47	238.6	63.9
8	07.7	02.1	68	65.7	17.6	28	123.6	33.1	88	181.6	48.7	48	239.5	64.2
9	08.7	02.3	69	66.6	17.9	29	124.6	33.4	89	182.6	48.9	49	240.5	64.4
10	09.7	02.6	70	67.6	18.1	30	125.6	33.6	90	183.5	49.2	50	241.5	64.7
11	10.6	02.8	71	68.6	18.4	131	126.5	33.9	191	184.5	49.4	251	242.4	65.0
12	11.6	03.1	72	69.5	18.6	32	127.5	34.2	92	185.5	49.7	52	243.4	65.2
13	12.6	03.4	73	70.5	18.9	33	128.5	34.4	93	186.4	50.0	53	244.4	65.5
14	13.5	03.6	74	71.5	19.2	34	129.4	34.7	94	187.4	50.2	54	245.3	65.7
15	14.5	03.9	75	72.4	19.4	35	130.4	34.9	95	188.4	50.5	55	246.3	66.0
16	15.5	04.1	76	73.4	19.7	36	131.4	35.2	96	189.3	50.7	56	247.3	66.3
17	16.4	04.4	77	74.4	19.9	37	132.3	35.5	97	190.3	51.0	57	248.2	66.5
18	17.4	04.7	78	75.3	20.2	38	133.3	35.7	98	191.3	51.2	58	249.2	66.8
19	18.4	04.9	79	76.3	20.4	39	134.3	36.0	99	192.2	51.5	59	250.2	67.0
20	19.3	05.2	80	77.3	20.7	40	135.2	36.2	200	193.2	51.8	60	251.1	67.3
21	20.3	05.4	81	78.2	21.0	141	136.2	36.5	201	194.2	52.0	261	252.1	67.6
22	21.2	05.7	82	79.2	21.2	42	137.2	36.8	02	195.1	52.3	62	253.1	67.8
23	22.2	06.0	83	80.2	21.5	43	138.1	37.0	03	196.1	52.5	63	254.0	68.1
24	23.2	06.2	84	81.1	21.7	44	139.1	37.3	04	197.0	52.8	64	255.0	68.3
25	24.1	06.5	85	82.1	22.0	45	140.1	37.5	05	198.0	53.1	65	256.0	68.6
26	25.1	06.7	86	83.1	22.3	46	141.0	37.8	06	199.0	53.3	66	256.9	68.8
27	26.1	07.0	87	84.0	22.5	47	142.0	38.0	07	199.9	53.6	67	257.9	69.1
28	27.0	07.2	88	85.0	22.8	48	143.0	38.3	08	200.9	53.8	68	258.9	69.4
29	28.0	07.5	89	86.0	23.0	49	143.9	38.6	09	201.9	54.1	69	259.8	69.6
30	29.0	07.8	90	86.9	23.3	50	144.9	38.8	10	202.8	54.4	70	260.8	69.9
31	29.9	08.0	91	87.9	23.6	151	145.9	39.1	211	203.8	54.6	271	261.8	70.1
32	30.9	08.3	92	88.9	23.8	52	146.8	39.3	12	204.8	54.9	72	262.7	70.4
33	31.9	08.5	93	89.8	24.1	53	147.8	39.6	13	205.7	55.1	73	263.7	70.7
34	32.8	08.8	94	90.8	24.3	54	148.8	39.9	14	206.7	55.4	74	264.7	70.9
35	33.8	09.1	95	91.8	24.6	55	149.7	40.1	15	207.7	55.6	75	265.6	71.2
36	34.8	09.3	96	92.7	24.8	56	150.7	40.4	16	208.6	55.9	76	266.6	71.4
37	35.7	09.6	97	93.7	25.1	57	151.7	40.6	17	209.6	56.2	77	267.6	71.7
38	36.7	09.8	98	94.7	25.4	58	152.6	40.9	18	210.6	56.4	78	268.5	72.0
39	37.7	10.1	99	95.6	25.6	59	153.6	41.2	19	211.5	56.7	79	269.5	72.2
40	38.6	10.4	100	96.6	25.9	60	154.5	41.4	20	212.5	56.9	80	270.5	72.5
41	39.6	10.6	101	97.6	26.1	161	155.5	41.7	221	213.5	57.2	281	271.4	72.7
42	40.6	10.9	02	98.5	26.4	62	156.5	41.9	22	214.4	57.5	82	272.4	73.0
43	41.5	11.1	03	99.5	26.7	63	157.4	42.2	23	215.4	57.7	83	273.4	73.2
44	42.5	11.4	04	100.5	26.9	64	158.4	42.4	24	216.4	58.0	84	274.3	73.5
45	43.5	11.6	05	101.4	27.2	65	159.4	42.7	25	217.3	58.2	85	275.3	73.8
46	44.4	11.9	06	102.4	27.4	66	160.3	43.0	26	218.3	58.5	86	276.3	74.0
47	45.4	12.2	07	103.4	27.7	67	161.3	43.2	27	219.3	58.8	87	277.2	74.3
48	46.4	12.4	08	104.3	28.0	68	162.3	43.5	28	220.2	59.0	88	278.2	74.5
49	47.3	12.7	09	105.3	28.2	69	163.2	43.7	29	221.2	59.3	89	279.2	74.8
50	48.3	12.9	10	106.3	28.5	70	164.2	44.0	30	222.2	59.5	90	280.1	75.1
51	49.3	13.2	111	107.2	28.7	171	165.2	44.3	231	223.1	59.8	291	281.1	75.3
52	50.2	13.5	12	108.2	29.0	72	166.1	44.5	32	224.1	60.0	92	282.1	75.6
53	51.2	13.7	13	109.1	29.2	73	167.1	44.8	33	225.1	60.3	93	283.0	75.8
54	52.2	14.0	14	110.1	29.5	74	168.1	45.0	34	226.0	60.6	94	284.0	76.1
55	53.1	14.2	15	111.1	29.8	75	169.0	45.3	35	227.0	60.8	95	284.9	76.4
56	54.1	14.5	16	112.0	30.0	76	170.0	45.6	36	228.0	61.1	96	285.9	76.6
57	55.1	14.8	17	113.0	30.3	77	171.0	45.8	37	228.9	61.3	97	286.9	76.9
58	56.0	15.0	18	114.0	30.5	78	171.9	46.1	38	229.9	61.6	98	287.8	77.1
59	57.0	15.3	19	114.9	30.8	79	172.9	46.3	39	230.9	61.9	99	288.8	77.4
60	58.0	15.5	20	115.9	31.1	80	173.9	46.6	40	231.8	62.1	300	289.8	77.6
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 75 Degrees.

TABLE II. Difference of Latitude and Departure for 18 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.3	61	58.0	18.9	121	115.1	37.4	181	172.1	55.9	241	229.2	74.5
2	01.9	00.6	62	59.0	19.2	22	116.0	37.7	82	173.1	56.2	42	230.2	74.8
3	02.9	00.9	63	59.9	19.5	23	117.0	38.0	83	174.0	56.6	43	231.1	75.1
4	03.8	01.2	64	60.9	19.8	24	117.9	38.3	84	175.0	56.9	44	232.1	75.4
5	04.8	01.5	65	61.8	20.1	25	118.9	38.6	85	175.9	57.2	45	233.0	75.7
6	05.7	01.9	66	62.8	20.4	26	119.8	38.9	86	176.9	57.5	46	234.0	76.0
7	06.7	02.2	67	63.7	20.7	27	120.8	39.2	87	177.8	57.8	47	234.9	76.3
8	07.6	02.5	68	64.7	21.0	28	121.7	39.6	88	178.8	58.1	48	235.9	76.6
9	08.6	02.8	69	65.6	21.3	29	122.7	39.9	89	179.7	58.4	49	236.8	76.9
10	09.5	03.1	70	66.6	21.6	30	123.6	40.2	90	180.7	58.7	50	237.8	77.3
11	10.5	03.4	71	67.5	21.9	131	124.6	40.5	191	181.7	59.0	251	238.7	77.6
12	11.4	03.7	72	68.5	22.2	32	125.5	40.8	92	182.6	59.3	52	239.7	77.9
13	12.4	04.0	73	69.4	22.6	33	126.5	41.1	93	183.6	59.6	53	240.6	78.2
14	13.3	04.3	74	70.4	22.9	34	127.4	41.4	94	184.5	59.9	54	241.6	78.5
15	14.3	04.6	75	71.3	23.2	35	128.4	41.7	95	185.5	60.3	55	242.5	78.8
16	15.2	04.9	76	72.3	23.5	36	129.3	42.0	96	186.4	60.6	56	243.5	79.1
17	16.2	05.3	77	73.2	23.8	37	130.3	42.3	97	187.4	60.9	57	244.4	79.4
18	17.1	05.6	78	74.2	24.1	38	131.2	42.6	98	188.3	61.2	58	245.4	79.7
19	18.1	05.9	79	75.1	24.4	39	132.2	43.0	99	189.3	61.5	59	246.3	80.0
20	19.0	06.2	80	76.1	24.7	40	133.1	43.3	200	190.2	61.8	60	247.3	80.3
21	20.0	06.5	81	77.0	25.0	141	134.1	43.6	201	191.2	62.1	261	248.2	80.7
22	20.9	06.8	82	78.0	25.3	42	135.1	43.9	02	192.1	62.4	62	249.2	81.0
23	21.9	07.1	83	78.9	25.6	43	136.0	44.2	03	193.1	62.7	63	250.1	81.3
24	22.8	07.4	84	79.9	26.0	44	137.0	44.5	04	194.0	63.0	64	251.1	81.6
25	23.8	07.7	85	80.8	26.3	45	137.9	44.8	05	195.0	63.3	65	252.0	81.9
26	24.7	08.0	86	81.8	26.6	46	138.9	45.1	06	195.9	63.7	66	253.0	82.2
27	25.7	08.3	87	82.7	26.9	47	139.8	45.4	07	196.9	64.0	67	253.9	82.5
28	26.6	08.7	88	83.7	27.2	48	140.8	45.7	08	197.8	64.3	68	254.9	82.8
29	27.6	09.0	89	84.6	27.5	49	141.7	46.0	09	198.8	64.6	69	255.8	83.1
30	28.5	09.3	90	85.6	27.8	50	142.7	46.4	10	199.7	64.9	70	256.8	83.4
31	29.5	09.6	91	86.5	28.1	151	143.6	46.7	211	200.7	65.2	271	257.7	83.7
32	30.4	09.9	92	87.5	28.4	52	144.6	47.0	12	201.6	65.5	72	258.7	84.1
33	31.4	10.2	93	88.4	28.7	53	145.5	47.3	13	202.6	65.8	73	259.6	84.4
34	32.3	10.5	94	89.4	29.0	54	146.5	47.6	14	203.5	66.1	74	260.6	84.7
35	33.3	10.8	95	90.4	29.4	55	147.4	47.9	15	204.5	66.4	75	261.5	85.0
36	34.2	11.1	96	91.3	29.7	56	148.4	48.2	16	205.4	66.7	76	262.5	85.3
37	35.2	11.4	97	92.3	30.0	57	149.3	48.5	17	206.4	67.1	77	263.4	85.6
38	36.1	11.7	98	93.2	30.3	58	150.3	48.8	18	207.3	67.4	78	264.4	85.9
39	37.1	12.1	99	94.2	30.6	59	151.2	49.1	19	208.3	67.7	79	265.3	86.2
40	38.0	12.4	100	95.1	30.9	60	152.2	49.4	20	209.2	68.0	80	266.3	86.5
41	39.0	12.7	101	96.1	31.2	161	153.1	49.8	221	210.2	68.3	281	267.2	86.8
42	39.9	13.0	02	97.0	31.5	62	154.1	50.1	22	211.1	68.6	82	268.2	87.1
43	40.9	13.3	03	98.0	31.8	63	155.0	50.4	23	212.1	68.9	83	269.1	87.4
44	41.8	13.6	04	98.9	32.1	64	156.0	50.7	24	213.0	69.2	84	270.1	87.8
45	42.8	13.9	05	99.9	32.4	65	156.9	51.0	25	214.0	69.5	85	271.1	88.1
46	43.7	14.2	06	100.8	32.8	66	157.9	51.3	26	214.9	69.8	86	272.0	88.4
47	44.7	14.5	07	101.8	33.1	67	158.8	51.6	27	215.9	70.1	87	273.0	88.7
48	45.7	14.8	08	102.7	33.4	68	159.8	51.9	28	216.8	70.5	88	273.9	89.0
49	46.6	15.1	09	103.7	33.7	69	160.7	52.2	29	217.8	70.8	89	274.9	89.3
50	47.6	15.5	10	104.6	34.0	70	161.7	52.5	30	218.7	71.1	90	275.8	89.6
51	48.5	15.8	111	105.6	34.3	171	162.6	52.8	231	219.7	71.4	291	276.8	89.9
52	49.5	16.1	12	106.5	34.6	72	163.6	53.2	32	220.6	71.7	92	277.7	90.2
53	50.4	16.4	13	107.5	34.9	73	164.5	53.5	33	221.6	72.0	93	278.7	90.5
54	51.4	16.7	14	108.4	35.2	74	165.5	53.8	34	222.5	72.3	94	279.6	90.9
55	52.3	17.0	15	109.4	35.5	75	166.4	54.1	35	223.5	72.6	95	280.6	91.2
56	53.3	17.3	16	110.3	35.8	76	167.4	54.4	36	224.4	72.9	96	281.5	91.5
57	54.2	17.6	17	111.3	36.2	77	168.3	54.7	37	225.4	73.2	97	282.5	91.8
58	55.2	17.9	18	112.2	36.5	78	169.3	55.0	38	226.4	73.5	98	283.4	92.1
59	56.1	18.2	19	113.2	36.8	79	170.2	55.3	39	227.3	73.9	99	284.4	92.4
60	57.1	18.5	20	114.1	37.1	80	171.2	55.6	40	228.3	74.2	300	285.3	92.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 72 Degrees.

TABLE II. Difference of Latitude and Departure for 17 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.3	61	58.3	17.8	121	115.7	35.4	181	173.1	52.9	241	230.5	70.5
2	01.9	00.6	62	59.3	18.1	22	116.7	35.7	82	174.0	53.2	42	231.4	70.7
3	02.9	00.9	63	60.2	18.4	23	117.6	36.0	83	175.0	53.5	43	232.4	71.0
4	03.8	01.2	64	61.2	18.7	24	118.6	36.3	84	176.0	53.8	44	233.3	71.3
5	04.8	01.5	65	62.2	19.0	25	119.5	36.5	85	176.9	54.1	45	234.3	71.6
6	05.7	01.8	66	63.1	19.3	26	120.5	36.8	86	177.9	54.4	46	235.3	71.9
7	06.7	02.0	67	64.1	19.6	27	121.5	37.1	87	178.8	54.7	47	236.2	72.2
8	07.7	02.3	68	65.0	19.9	28	122.4	37.4	88	179.8	55.0	48	237.2	72.7
9	08.6	02.6	69	66.0	20.2	29	123.4	37.7	89	180.7	55.3	49	238.1	72.4
10	09.6	02.9	70	66.9	20.5	30	124.3	38.0	90	181.7	55.6	50	239.1	73.0
11	10.5	03.2	71	67.9	20.8	131	125.3	38.3	191	182.7	55.8	251	240.0	73.3
12	11.5	03.5	72	68.9	20.9	32	126.2	38.6	92	183.6	56.1	52	241.0	73.6
13	12.4	03.8	73	69.8	21.3	33	127.2	38.9	93	184.6	56.4	53	241.9	74.0
14	13.4	04.1	74	70.8	21.6	34	128.1	39.2	94	185.5	56.7	54	242.9	74.1
15	14.3	04.4	75	71.7	21.9	35	129.1	39.5	95	186.5	57.0	55	243.9	74.4
16	15.3	04.7	76	72.7	22.2	36	130.1	39.8	96	187.4	57.3	56	241.8	74.7
17	16.3	05.0	77	73.6	22.5	37	131.0	40.1	97	188.4	57.6	57	245.2	75.1
18	17.2	05.3	78	74.6	22.8	38	132.0	40.3	98	189.3	57.9	58	246.7	75.3
19	18.2	05.6	79	75.5	23.1	39	132.9	40.6	99	190.3	58.2	59	247.7	75.6
20	19.1	05.8	80	76.5	23.4	40	133.9	40.9	200	191.3	58.5	60	248.6	75.9
21	20.1	06.1	81	77.5	23.7	141	134.8	41.2	201	192.2	58.8	261	249.6	76.2
22	21.0	06.4	82	78.4	24.0	42	135.8	41.5	02	193.2	59.1	62	250.6	76.6
23	22.0	06.7	83	79.4	24.3	43	136.8	41.8	03	194.1	59.4	63	251.5	76.8
24	22.9	07.0	84	80.3	24.6	44	137.7	42.1	04	195.1	59.6	64	252.5	77.1
25	23.9	07.3	85	81.3	24.9	45	138.7	42.4	05	196.0	59.9	65	253.4	77.4
26	24.9	07.6	86	82.2	25.1	46	139.6	42.7	06	197.0	60.2	66	254.4	77.7
27	25.8	07.9	87	83.2	25.4	47	140.6	43.0	07	198.0	60.5	67	255.3	78.1
28	26.8	08.2	88	84.2	25.7	48	141.5	43.3	08	198.9	60.8	68	256.3	78.4
29	27.7	08.5	89	85.1	26.0	49	142.5	43.6	09	199.9	61.1	69	257.2	78.6
30	28.7	08.8	90	86.1	26.3	50	143.4	43.9	10	200.8	61.4	70	258.2	78.9
31	29.6	09.1	91	87.0	26.6	151	144.4	44.1	211	201.8	61.7	271	259.2	79.2
32	30.6	09.4	92	88.0	26.9	52	145.4	44.4	12	202.7	62.0	72	260.1	79.5
33	31.6	09.6	93	88.9	27.2	53	146.3	44.7	13	203.7	62.3	73	261.1	79.7
34	32.5	09.9	94	89.9	27.5	54	147.3	45.0	14	204.6	62.6	74	262.0	80.0
35	33.5	10.2	95	90.8	27.8	55	148.2	45.3	15	205.6	62.9	75	263.0	80.3
36	34.4	10.5	96	91.8	28.1	56	149.2	45.6	16	206.6	63.2	76	263.9	80.6
37	35.4	10.8	97	92.8	28.4	57	150.1	45.9	17	207.5	63.4	77	264.9	81.0
38	36.3	11.1	98	93.7	28.7	58	151.1	46.2	18	208.5	63.7	78	265.9	81.2
39	37.3	11.4	99	94.7	28.9	59	152.1	46.5	19	209.4	64.0	79	266.8	81.5
40	38.3	11.7	100	95.6	29.2	60	153.0	46.8	20	210.4	64.3	80	267.8	81.7
41	39.2	12.0	101	96.6	29.5	161	154.0	47.1	221	211.3	64.6	281	268.7	82.0
42	40.2	12.3	02	97.5	29.8	62	154.9	47.4	22	212.3	64.9	82	269.7	82.3
43	41.1	12.6	03	98.5	30.1	63	155.9	47.7	23	213.3	65.2	83	270.6	82.6
44	42.1	12.9	04	99.5	30.4	64	156.8	47.9	24	214.2	65.5	84	271.6	82.9
45	43.0	13.2	05	100.4	30.7	65	157.8	48.2	25	215.2	65.8	85	272.5	83.2
46	44.0	13.4	06	101.4	31.0	66	158.7	48.5	26	216.1	66.1	86	273.5	83.5
47	44.9	13.7	07	102.3	31.3	67	159.7	48.8	27	217.1	66.4	87	274.5	83.9
48	45.9	14.0	08	103.3	31.6	68	160.7	49.1	28	218.0	66.7	88	275.4	84.1
49	46.9	14.3	09	104.2	31.9	69	161.6	49.4	29	219.0	67.0	89	276.4	84.4
50	47.8	14.6	10	105.2	32.2	70	162.6	49.7	30	220.0	67.2	90	277.3	84.7
51	48.8	14.9	111	106.1	32.5	171	163.5	50.0	231	220.9	67.5	291	278.3	85.0
52	49.7	15.2	12	107.1	32.7	72	164.5	50.3	32	221.9	67.8	92	279.2	85.4
53	50.7	15.5	13	108.1	33.0	73	165.4	50.6	33	222.8	68.1	93	280.2	85.7
54	51.6	15.8	14	109.0	33.3	74	166.4	50.9	34	223.8	68.4	94	281.2	86.0
55	52.6	16.1	15	110.0	33.6	75	167.4	51.2	35	224.7	68.7	95	282.1	86.1
56	53.6	16.4	16	110.9	33.9	76	168.3	51.5	36	225.7	69.0	96	283.1	86.4
57	54.5	16.7	17	111.9	34.2	77	169.3	51.7	37	226.6	69.3	97	284.0	86.8
58	55.5	17.0	18	112.8	34.5	78	170.2	52.0	38	227.6	69.6	98	285.0	87.0
59	56.4	17.2	19	113.8	34.8	79	171.2	52.3	39	228.6	69.9	99	285.9	87.3
60	57.4	17.5	20	114.8	35.1	80	172.1	52.6	40	229.5	70.2	300	286.9	87.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 73 Degrees.

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TABLE II. Difference of Latitude and Departure for 20 Degrees.

Dist.	Lat.	Dep.	Dist	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.3	61	57.3	20.9	121	113.7	41.4	181	170.1	61.9	241	226.5	82.4
2	01.9	00.7	62	58.3	21.2	22	114.6	41.7	82	171.0	62.2	42	227.4	82.8
3	02.8	01.0	63	59.2	21.5	23	115.6	42.1	83	172.0	62.6	43	228.3	83.1
4	03.8	01.4	64	60.1	21.9	24	116.5	42.4	84	172.9	62.9	44	229.3	83.5
5	04.7	01.7	65	61.1	22.2	25	117.5	42.8	85	173.8	63.3	45	230.2	83.8
6	05.6	02.1	66	62.0	22.6	26	118.4	43.1	86	174.8	63.6	46	231.2	84.1
7	06.6	02.4	67	63.0	22.9	27	119.3	43.4	87	175.7	64.0	47	232.1	84.5
8	07.5	02.7	68	63.9	23.3	28	120.3	43.8	88	176.7	64.3	48	233.0	84.8
9	08.5	03.1	69	64.8	23.6	29	121.2	44.1	89	177.6	64.6	49	234.0	85.2
10	09.4	03.4	70	65.8	23.9	30	122.2	44.5	90	178.5	65.0	50	234.9	85.5
11	10.3	03.8	71	66.7	24.3	131	123.1	44.8	191	179.5	65.3	251	235.9	85.8
12	11.3	04.1	72	67.7	24.6	32	124.0	45.1	92	180.4	65.7	52	236.8	86.2
13	12.2	04.4	73	68.6	25.0	33	125.0	45.5	93	181.4	66.0	53	237.7	86.5
14	13.2	04.8	74	69.5	25.3	34	125.9	45.8	94	182.3	66.4	54	238.7	86.9
15	14.1	05.1	75	70.5	25.7	35	126.9	46.2	95	183.2	66.7	55	239.6	87.2
16	15.0	05.5	76	71.4	26.0	36	127.8	46.5	96	184.2	67.0	56	240.6	87.6
17	16.0	05.8	77	72.4	26.3	37	128.7	46.9	97	185.1	67.4	57	241.5	87.9
18	16.9	06.2	78	73.3	26.7	38	129.7	47.2	98	186.1	67.7	58	242.4	88.2
19	17.9	06.5	79	74.2	27.0	39	130.6	47.5	99	187.0	68.1	59	243.4	88.6
20	18.8	06.8	80	75.2	27.4	40	131.6	47.9	200	187.9	68.4	60	244.3	88.9
21	19.7	07.2	81	76.1	27.7	141	132.5	48.2	201	188.9	68.7	261	245.3	89.3
22	20.7	07.5	82	77.1	28.0	42	133.4	48.6	02	189.8	69.1	62	246.2	89.6
23	21.6	07.9	83	78.0	28.4	43	134.4	48.9	03	190.8	69.4	63	247.1	90.0
24	22.6	08.2	84	78.9	28.7	44	135.3	49.3	04	191.7	69.8	64	248.1	90.3
25	23.5	08.6	85	79.9	29.1	45	136.3	49.6	05	192.6	70.1	65	249.0	90.6
26	24.4	08.9	86	80.8	29.4	46	137.2	49.9	06	193.6	70.5	66	250.0	91.0
27	25.4	09.2	87	81.8	29.8	47	138.1	50.3	07	194.5	70.8	67	250.9	91.3
28	26.3	09.6	88	82.7	30.1	48	139.1	50.6	08	195.5	71.1	68	251.8	91.7
29	27.3	09.9	89	83.6	30.4	49	140.0	51.0	09	196.4	71.5	69	252.8	92.0
30	28.2	10.3	90	84.6	30.8	50	141.0	51.3	10	197.3	71.8	70	253.7	92.3
31	29.1	10.6	91	85.5	31.1	151	141.9	51.6	211	198.3	72.2	271	254.7	92.7
32	30.1	10.9	92	86.5	31.5	52	142.8	52.0	12	199.2	72.5	72	255.6	93.0
33	31.0	11.3	93	87.4	31.8	53	143.8	52.3	13	200.2	72.9	73	256.5	93.4
34	31.9	11.6	94	88.3	32.1	54	144.7	52.7	14	201.1	73.2	74	257.5	93.7
35	32.9	12.0	95	89.3	32.5	55	145.7	53.0	15	202.0	73.5	75	258.4	94.1
36	33.8	12.3	96	90.2	32.8	56	146.6	53.4	16	203.0	73.9	76	259.4	94.4
37	34.8	12.7	97	91.2	33.2	57	147.5	53.7	17	203.9	74.2	77	260.3	94.7
38	35.7	13.0	98	92.1	33.5	58	148.5	54.0	18	204.9	74.6	78	261.2	95.1
39	36.6	13.3	99	93.0	33.9	59	149.4	54.4	19	205.8	74.9	79	262.2	95.4
40	37.6	13.7	100	94.0	34.2	60	150.4	54.7	20	206.7	75.2	80	263.1	95.8
41	38.5	14.0	101	94.9	34.5	161	151.3	55.1	221	207.7	75.6	281	264.1	96.1
42	39.5	14.4	02	95.8	34.9	62	152.2	55.4	22	208.6	75.9	82	265.0	96.4
43	40.4	14.7	03	96.8	35.2	63	153.2	55.7	23	209.6	76.3	83	265.9	96.8
44	41.3	15.0	04	97.7	35.6	64	154.1	56.1	24	210.5	76.6	84	266.9	97.1
45	42.3	15.4	05	98.7	35.9	65	155.0	56.4	25	211.4	77.0	85	267.8	97.5
46	43.2	15.7	06	99.6	36.3	66	156.0	56.8	26	212.4	77.3	86	268.8	97.8
47	44.2	16.1	07	100.5	36.6	67	156.9	57.1	27	213.3	77.6	87	269.7	98.2
48	45.1	16.4	08	101.5	36.9	68	157.9	57.5	28	214.2	78.0	88	270.6	98.5
49	46.0	16.8	09	102.4	37.3	69	158.8	57.8	29	215.2	78.3	89	271.6	98.8
50	47.0	17.1	10	103.4	37.6	70	159.7	58.1	30	216.1	78.7	90	272.5	99.2
51	47.9	17.4	111	104.3	38.0	171	160.7	58.5	231	217.1	79.0	291	273.5	99.5
52	48.9	17.8	12	105.2	38.3	72	161.6	58.8	32	218.0	79.3	92	274.4	99.9
53	49.8	18.1	13	106.2	38.6	73	162.6	59.2	33	219.0	79.7	93	275.3	100.1
54	50.7	18.5	14	107.1	39.0	74	163.5	59.5	34	219.9	80.0	94	276.3	100.5
55	51.7	18.8	15	108.1	39.3	75	164.4	59.9	35	220.8	80.4	95	277.2	100.9
56	52.6	19.2	16	109.0	39.7	76	165.4	60.2	36	221.8	80.7	96	278.1	101.2
57	53.6	19.5	17	109.9	40.0	77	166.3	60.5	37	222.7	81.1	97	279.1	101.6
58	54.5	19.8	18	110.9	40.4	78	167.3	60.9	38	223.6	81.4	98	280.0	101.9
59	55.4	20.2	19	111.8	40.7	79	168.2	61.2	39	224.6	81.7	99	281.0	102.3
60	56.4	20.5	20	112.8	41.0	80	169.1	61.6	40	225.5	82.1	300	281.9	102.6
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 70 Degrees.

TABLE II. Difference of Latitude and Departure for 19 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.3	61	57.7	19.9	121	114.4	39.4	181	171.1	58.9	241	227.9	78.5
2	01.9	00.7	62	58.6	20.2	22	115.4	39.7	82	172.1	59.3	42	228.8	78.8
3	02.8	01.0	63	59.6	20.5	23	116.3	40.0	83	173.0	59.6	43	229.8	79.1
4	03.8	01.3	64	60.5	20.8	24	117.2	40.4	84	174.0	59.9	44	230.7	79.4
5	04.7	01.6	65	61.5	21.2	25	118.2	40.7	85	174.9	60.2	45	231.7	79.8
6	05.7	02.0	66	62.4	21.5	26	119.1	41.0	86	175.9	60.6	46	232.6	80.1
7	06.6	02.3	67	63.3	21.8	27	120.1	41.3	87	176.8	60.9	47	233.5	80.4
8	07.6	02.6	68	64.3	22.1	28	121.0	41.7	88	177.8	61.2	48	234.5	80.7
9	08.5	02.9	69	65.2	22.5	29	122.0	42.0	89	178.7	61.5	49	235.4	81.1
10	09.5	03.3	70	66.2	22.8	30	122.9	42.3	90	179.6	61.9	50	236.4	81.4
11	10.4	03.6	71	67.1	23.1	131	123.9	42.6	191	180.6	62.2	251	237.3	81.7
12	11.3	03.9	72	68.1	23.4	32	124.8	43.0	92	181.5	62.5	52	238.3	82.0
13	12.3	04.2	73	69.0	23.8	33	125.8	43.3	93	182.5	62.8	53	239.2	82.4
14	13.2	04.6	74	70.0	24.1	34	126.7	43.6	94	183.4	63.2	54	240.2	82.7
15	14.2	04.9	75	70.9	24.4	35	127.6	44.0	95	184.4	63.5	55	241.1	83.0
16	15.1	05.2	76	71.9	24.7	36	128.6	44.3	96	185.3	63.8	56	242.1	83.3
17	16.1	05.5	77	72.8	25.1	37	129.5	44.6	97	186.3	64.1	57	243.0	83.7
18	17.0	05.9	78	73.8	25.4	38	130.5	44.9	98	187.2	64.5	58	243.9	84.0
19	18.0	06.2	79	74.7	25.7	39	131.4	45.3	99	188.2	64.8	59	244.9	84.3
20	18.9	06.5	80	75.6	26.0	40	132.4	45.6	200	189.1	65.1	60	245.8	84.6
21	19.9	06.8	81	76.6	26.4	141	133.3	45.9	201	190.0	65.4	261	246.8	85.0
22	20.8	07.2	82	77.5	26.7	42	134.3	46.2	02	191.0	65.8	62	247.7	85.3
23	21.7	07.5	83	78.5	27.0	43	135.2	46.6	03	191.9	66.1	63	248.7	85.6
24	22.7	07.8	84	79.4	27.4	44	136.2	46.9	04	192.9	66.4	64	249.6	86.0
25	23.6	08.1	85	80.4	27.7	45	137.1	47.2	05	193.8	66.7	65	250.6	86.3
26	24.6	08.5	86	81.3	28.0	46	138.0	47.5	06	194.8	67.1	66	251.5	86.6
27	25.5	08.8	87	82.3	28.3	47	139.0	47.9	07	195.7	67.4	67	252.5	86.9
28	26.5	09.1	88	83.2	28.7	48	139.9	48.2	08	196.7	67.7	68	253.4	87.3
29	27.4	09.4	89	84.2	29.0	49	140.9	48.5	09	197.6	68.0	69	254.3	87.6
30	28.4	09.8	90	85.1	29.3	50	141.8	48.8	10	198.6	68.4	70	255.3	87.9
31	29.3	10.1	91	86.0	29.6	151	142.8	49.2	211	199.5	68.7	271	256.2	88.2
32	30.3	10.4	92	87.0	30.0	52	143.7	49.5	12	200.4	69.0	72	257.2	88.6
33	31.2	10.7	93	87.9	30.3	53	144.7	49.8	13	201.4	69.3	73	258.1	88.9
34	32.1	11.1	94	88.9	30.6	54	145.6	50.1	14	202.3	69.7	74	259.1	89.2
35	33.1	11.4	95	89.8	30.9	55	146.6	50.5	15	203.3	70.0	75	260.0	89.5
36	34.0	11.7	96	90.8	31.3	56	147.5	50.8	16	204.2	70.3	76	261.0	89.9
37	35.0	12.0	97	91.7	31.6	57	148.4	51.1	17	205.2	70.6	77	261.9	90.2
38	35.9	12.4	98	92.7	31.9	58	149.4	51.4	18	206.1	71.0	78	262.9	90.5
39	36.9	12.7	99	93.6	32.2	59	150.3	51.8	19	207.1	71.3	79	263.8	90.8
40	37.8	13.0	100	94.6	32.6	60	151.3	52.1	20	208.0	71.6	80	264.7	91.2
41	38.8	13.3	101	95.5	32.9	161	152.2	52.4	221	209.0	72.0	281	265.7	91.5
42	39.7	13.7	02	96.4	33.2	62	153.2	52.7	22	209.9	72.3	82	266.6	91.8
43	40.7	14.0	03	97.4	33.5	63	154.1	53.1	23	210.9	72.6	83	267.6	92.1
44	41.6	14.3	04	98.3	33.9	64	155.1	53.4	24	211.8	72.9	84	268.5	92.5
45	42.5	14.7	05	99.3	34.2	65	156.0	53.7	25	212.7	73.3	85	269.5	92.8
46	43.5	15.0	06	100.2	34.5	66	157.0	54.0	26	213.7	73.6	86	270.4	93.1
47	44.4	15.3	07	101.2	34.8	67	157.9	54.4	27	214.6	73.9	87	271.4	93.4
48	45.4	15.6	08	102.1	35.2	68	158.8	54.7	28	215.6	74.2	88	272.3	93.8
49	46.3	16.0	09	103.1	35.5	69	159.8	55.0	29	216.5	74.6	89	273.3	94.1
50	47.3	16.3	10	104.0	35.8	70	160.7	55.3	30	217.5	74.9	90	274.2	94.4
51	48.2	16.6	111	105.0	36.1	171	161.7	55.7	231	218.4	75.2	291	275.1	94.7
52	49.2	16.9	12	105.9	36.5	72	162.6	56.0	32	219.4	75.5	92	276.1	95.1
53	50.1	17.3	13	106.8	36.8	73	163.6	56.3	33	220.3	75.9	93	277.0	95.4
54	51.1	17.6	14	107.8	37.1	74	164.5	56.6	34	221.2	76.2	94	278.0	95.7
55	52.0	17.9	15	108.7	37.4	75	165.5	57.0	35	222.2	76.5	95	278.9	96.0
56	52.9	18.2	16	109.7	37.8	76	166.4	57.3	36	223.1	76.8	96	279.9	96.4
57	53.9	18.6	17	110.6	38.1	77	167.4	57.6	37	224.1	77.2	97	280.8	96.7
58	54.8	18.9	18	111.6	38.4	78	168.3	58.0	38	225.0	77.5	98	281.8	97.0
59	55.8	19.2	19	112.5	38.7	79	169.2	58.3	39	226.0	77.8	99	282.7	97.3
60	56.7	19.5	20	113.5	39.1	80	170.2	58.6	40	226.9	78.1	300	283.6	97.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 71 Degrees.

TABLE II. Difference of Latitude and Departure for 22 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.4	61	56.6	22.9	121	112.2	45.3	181	167.8	67.8	241	223.5	90.3
2	01.9	00.7	62	57.5	23.2	22	113.1	45.7	82	168.7	68.2	42	224.4	90.7
3	02.8	01.1	63	58.4	23.6	23	114.0	46.1	83	169.7	68.6	43	225.3	91.0
4	03.7	01.5	64	59.3	24.0	24	115.0	46.5	84	170.6	68.9	44	226.2	91.4
5	04.6	01.9	65	60.3	24.3	25	115.9	46.8	85	171.5	69.3	45	227.2	91.8
6	05.6	02.2	66	61.2	24.7	26	116.8	47.2	86	172.5	69.7	46	228.1	92.2
7	06.5	02.6	67	62.1	25.1	27	117.8	47.6	87	173.4	70.1	47	229.0	92.5
8	07.4	03.0	68	63.0	25.5	28	118.7	47.9	88	174.3	70.4	48	229.9	92.9
9	08.3	03.4	69	64.0	25.8	29	119.6	48.3	89	175.2	70.8	49	230.9	93.3
10	09.3	03.7	70	64.9	26.2	30	120.5	48.7	90	176.2	71.2	50	231.8	93.7
11	10.2	04.1	71	65.8	26.6	131	121.5	49.1	191	177.1	71.5	251	232.7	94.0
12	11.1	04.5	72	66.8	27.0	32	122.4	49.4	92	178.0	71.9	52	233.7	94.4
13	12.1	04.9	73	67.7	27.3	33	123.3	49.8	93	178.9	72.3	53	234.6	94.8
14	13.0	05.2	74	68.6	27.7	34	124.2	50.2	94	179.9	72.7	54	235.5	95.2
15	13.9	05.6	75	69.5	28.1	35	125.2	50.6	95	180.8	73.0	55	236.4	95.5
16	14.8	06.0	76	70.5	28.5	36	126.1	50.9	96	181.7	73.4	56	237.4	95.9
17	15.8	06.4	77	71.4	28.8	37	127.0	51.3	97	182.7	73.8	57	238.3	96.3
18	16.7	06.7	78	72.3	29.2	38	128.0	51.7	98	183.6	74.2	58	239.2	96.6
19	17.6	07.1	79	73.2	29.6	39	128.9	52.1	99	184.5	74.5	59	240.1	97.0
20	18.5	07.5	80	74.2	30.0	40	129.8	52.4	200	185.4	74.9	60	241.1	97.4
21	19.5	07.9	81	75.1	30.3	141	130.7	52.8	201	186.4	75.3	261	242.0	97.8
22	20.4	08.2	82	76.0	30.7	42	131.7	53.2	02	187.3	75.7	62	242.9	98.1
23	21.3	08.6	83	77.0	31.1	43	132.6	53.6	03	188.2	76.0	63	243.8	98.5
24	22.3	09.0	84	77.9	31.5	44	133.5	53.9	04	189.1	76.4	64	244.8	98.9
25	23.2	09.4	85	78.8	31.8	45	134.4	54.3	05	190.1	76.8	65	245.7	99.3
26	24.1	09.7	86	79.7	32.2	46	135.4	54.7	06	191.0	77.2	66	246.6	99.6
27	25.0	10.1	87	80.7	32.6	47	136.3	55.1	07	191.9	77.5	67	247.6	100.0
28	26.0	10.5	88	81.6	33.0	48	137.2	55.4	08	192.9	77.9	68	248.5	100.4
29	26.9	10.9	89	82.5	33.3	49	138.2	55.8	09	193.8	78.3	69	249.4	100.8
30	27.8	11.2	90	83.4	33.7	50	139.1	56.2	10	194.7	78.7	70	250.3	101.1
31	28.7	11.6	91	84.4	34.1	151	140.0	56.6	211	195.6	79.0	271	251.3	101.5
32	29.7	12.0	92	85.3	34.5	52	140.9	56.9	12	196.6	79.4	72	252.2	101.9
33	30.6	12.4	93	86.2	34.8	53	141.9	57.3	13	197.5	79.8	73	253.1	102.3
34	31.5	12.7	94	87.2	35.2	54	142.8	57.7	14	198.4	80.2	74	254.1	102.6
35	32.5	13.1	95	88.1	35.6	55	143.7	58.1	15	199.3	80.5	75	255.0	103.0
36	33.4	13.5	96	89.0	36.0	56	144.6	58.4	16	200.3	80.9	76	255.9	103.4
37	34.3	13.9	97	89.9	36.3	57	145.6	58.8	17	201.2	81.3	77	256.8	103.8
38	35.2	14.2	98	90.9	36.7	58	146.5	59.2	18	202.1	81.7	78	257.8	104.1
39	36.2	14.6	99	91.8	37.1	59	147.4	59.6	19	203.1	82.0	79	258.7	104.5
40	37.1	15.0	100	92.7	37.5	60	148.3	59.9	20	204.0	82.4	80	259.6	104.9
41	38.0	15.4	101	93.6	37.8	161	149.3	60.3	221	204.9	82.8	281	260.5	105.3
42	38.9	15.7	02	94.6	38.2	62	150.2	60.7	22	205.8	83.2	82	261.5	105.6
43	39.9	16.1	03	95.5	38.6	63	151.1	61.1	23	206.8	83.5	83	262.4	106.0
44	40.8	16.5	04	96.4	39.0	64	152.1	61.4	24	207.7	83.9	84	263.3	106.4
45	41.7	16.9	05	97.4	39.3	65	153.0	61.8	25	208.6	84.3	85	264.2	106.8
46	42.7	17.2	06	98.3	39.7	66	153.9	62.2	26	209.5	84.7	86	265.2	107.1
47	43.6	17.6	07	99.2	40.1	67	154.8	62.6	27	210.5	85.0	87	266.1	107.5
48	44.5	18.0	08	100.1	40.5	68	155.8	62.9	28	211.4	85.4	88	267.0	107.9
49	45.4	18.4	09	101.1	40.8	69	156.7	63.3	29	212.3	85.8	89	268.0	108.3
50	46.4	18.7	10	102.0	41.2	70	157.6	63.7	30	213.3	86.2	90	268.9	108.6
51	47.3	19.1	111	102.9	41.6	171	158.5	64.1	231	214.2	86.5	291	269.8	109.0
52	48.2	19.5	12	103.8	42.0	72	159.5	64.4	32	215.1	86.9	92	270.7	109.4
53	49.1	19.9	13	104.8	42.3	73	160.4	64.8	33	216.0	87.3	93	271.7	109.8
54	50.1	20.2	14	105.7	42.7	74	161.3	65.2	34	217.0	87.7	94	272.6	110.1
55	51.0	20.6	15	106.6	43.1	75	162.3	65.6	35	217.9	88.0	95	273.5	110.5
56	51.9	21.0	16	107.6	43.5	76	163.2	65.9	36	218.8	88.4	96	274.4	110.9
57	52.8	21.4	17	108.5	43.8	77	164.1	66.3	37	219.7	88.8	97	275.4	111.3
58	53.8	21.7	18	109.4	44.2	78	165.0	66.7	38	220.7	89.2	98	276.3	111.6
59	54.7	22.1	19	110.3	44.6	79	166.0	67.1	39	221.6	89.5	99	277.2	112.0
60	55.6	22.5	20	111.3	45.0	80	166.9	67.4	40	222.5	89.9	300	278.2	112.4
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 68 Degrees.

TABLE II. Difference of Latitude and Departure for 21 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist	Lat.	Dep.	Dist.	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	56.9	21.9	121	113.0	43.4	181	169.0	64.9	241	225.0	86.4
2	01.9	00.7	62	57.9	22.2	22	113.9	43.7	82	169.9	65.2	42	225.9	86.7
3	02.8	01.1	63	58.8	22.6	23	114.8	44.1	83	170.8	65.6	43	226.9	87.1
4	03.7	01.4	64	59.7	22.9	24	115.8	44.4	84	171.8	65.9	44	227.8	87.4
5	04.7	01.8	65	60.7	23.3	25	116.7	44.8	85	172.7	66.3	45	228.7	87.8
6	05.6	02.2	66	61.6	23.7	26	117.6	45.2	86	173.6	66.7	46	229.7	88.2
7	06.5	02.5	67	62.5	24.0	27	118.6	45.5	87	174.6	67.0	47	230.6	88.5
8	07.5	02.9	68	63.5	24.4	28	119.5	45.9	88	175.5	67.4	48	231.5	88.9
9	08.4	03.2	69	64.4	24.7	29	120.4	46.1	89	176.4	67.7	49	232.5	89.2
10	09.3	03.6	70	65.4	25.1	30	121.4	46.6	90	177.4	68.1	50	233.4	89.6
11	10.3	03.9	71	66.3	25.4	131	122.3	46.9	191	178.3	68.4	251	234.3	90.0
12	11.2	04.3	72	67.2	25.8	32	123.2	47.3	92	179.2	68.8	52	235.3	90.3
13	12.1	04.7	73	68.2	26.2	33	124.2	47.7	93	180.2	69.2	53	236.2	90.7
14	13.1	05.0	74	69.1	26.5	34	125.1	48.0	94	181.1	69.5	54	237.1	91.0
15	14.0	05.4	75	70.0	26.9	35	126.0	48.4	95	182.0	69.9	55	238.1	91.4
16	14.9	05.7	76	70.9	27.2	36	127.0	48.7	96	183.0	70.2	56	239.0	91.7
17	15.9	06.1	77	71.9	27.6	37	127.9	49.1	97	183.9	70.6	57	239.9	92.1
18	16.8	06.5	78	72.8	28.0	38	128.8	49.5	98	184.8	71.0	58	240.9	92.5
19	17.7	06.8	79	73.8	28.3	39	129.8	49.8	99	185.8	71.3	59	241.8	92.8
20	18.7	07.2	80	74.7	28.7	40	130.7	50.2	200	186.7	71.7	60	242.7	93.2
21	19.6	07.5	81	75.6	29.0	141	131.6	50.5	201	187.6	72.0	261	243.7	93.5
22	20.5	07.9	82	76.6	29.4	42	132.6	50.9	02	188.6	72.4	62	244.6	93.9
23	21.5	08.2	83	77.5	29.7	43	133.5	51.2	03	189.5	72.7	63	245.5	94.3
24	22.4	08.6	84	78.4	30.1	44	134.4	51.6	04	190.5	73.1	64	246.5	94.6
25	23.3	09.0	85	79.4	30.5	45	135.4	52.0	05	191.4	73.5	65	247.4	95.0
26	24.3	09.3	86	80.3	30.8	46	136.3	52.3	06	192.3	73.8	66	248.3	95.3
27	25.2	09.7	87	81.2	31.2	47	137.2	52.7	07	193.2	74.2	67	249.3	95.7
28	26.1	10.0	88	82.2	31.5	48	138.2	53.0	08	194.2	74.5	68	250.2	96.0
29	27.1	10.4	89	83.1	31.9	49	139.1	53.4	09	195.1	74.9	69	251.1	96.4
30	28.0	10.8	90	84.0	32.3	50	140.0	53.8	10	196.1	75.3	70	252.1	96.8
31	28.9	11.1	91	85.0	32.6	151	141.0	54.1	211	197.0	75.6	271	253.0	97.1
32	29.9	11.5	92	85.9	33.0	52	141.9	54.5	12	197.9	76.0	72	253.9	97.5
33	30.8	11.8	93	86.8	33.3	53	142.8	54.8	13	198.9	76.3	73	254.9	97.8
34	31.7	12.2	94	87.8	33.7	54	143.8	55.2	14	199.8	76.7	74	255.8	98.2
35	32.7	12.5	95	88.7	34.0	55	144.7	55.5	15	200.7	77.0	75	256.7	98.6
36	33.6	12.9	96	89.6	34.4	56	145.6	55.9	16	201.7	77.4	76	257.7	98.9
37	34.5	13.3	97	90.6	34.8	57	146.6	56.3	17	202.6	77.8	77	258.6	99.3
38	35.5	13.6	98	91.5	35.1	58	147.5	56.6	18	203.5	78.1	78	259.5	99.6
39	36.4	14.0	99	92.4	35.5	59	148.4	57.0	19	204.5	78.5	79	260.5	100.0
40	37.3	14.3	100	93.4	35.8	60	149.4	57.3	20	205.4	78.8	80	261.4	100.3
41	38.3	14.7	101	94.3	36.2	161	150.3	57.7	221	206.3	79.2	281	262.3	100.7
42	39.2	15.1	02	95.2	36.6	62	151.2	58.1	22	207.3	79.6	82	263.3	101.1
43	40.1	15.4	03	96.2	36.9	63	152.2	58.4	23	208.2	79.9	83	264.2	101.4
44	41.1	15.8	04	97.1	37.3	64	153.1	58.8	24	209.1	80.3	84	265.1	101.8
45	42.0	16.1	05	98.0	37.6	65	154.0	59.1	25	210.1	80.6	85	266.1	102.1
46	42.9	16.5	06	99.0	38.0	66	155.0	59.5	26	211.0	81.0	86	267.0	102.5
47	43.9	16.8	07	99.9	38.3	67	155.9	59.8	27	211.9	81.3	87	267.9	102.9
48	44.8	17.2	08	100.8	38.7	68	156.8	60.2	28	212.9	81.7	88	268.9	103.2
49	45.7	17.6	09	101.8	39.1	69	157.8	60.6	29	213.8	82.1	89	269.8	103.6
50	46.7	17.9	10	102.7	39.4	70	158.7	60.9	30	214.7	82.4	90	260.7	103.9
51	47.6	18.3	111	103.6	39.8	171	159.6	61.3	231	215.7	82.8	291	271.7	104.3
52	48.5	18.6	12	104.6	40.1	72	160.6	61.6	32	216.6	83.1	92	272.6	104.6
53	49.5	19.0	13	105.5	40.5	73	161.5	62.0	33	217.5	83.5	93	273.5	105.0
54	50.4	19.4	14	106.4	40.9	74	162.4	62.4	34	218.5	83.9	94	274.5	105.4
55	51.3	19.7	15	107.4	41.2	75	163.4	62.7	35	219.4	84.2	95	275.4	105.7
56	52.3	20.1	16	108.3	41.6	76	164.3	63.1	36	220.3	84.6	96	276.3	106.1
57	53.2	20.4	17	109.2	41.9	77	165.2	63.4	37	221.3	84.9	97	277.3	106.4
58	54.1	20.8	18	110.2	42.3	78	166.2	63.8	38	222.2	85.3	98	278.2	106.8
59	55.1	21.1	19	111.1	42.6	79	167.1	64.1	39	223.1	85.6	99	279.1	107.2
60	56.0	21.5	20	112.0	43.0	80	168.0	64.5	40	224.1	86.0	300	280.1	107.5
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist	Dep.	Lat.	Dist.	Dep	Lat.	Dist.	Dep.	Lat.

for 69 Degrees.

TABLE II. Difference of Latitude and Departure for 24 Degrees.

Dist.	Lat.	Dep.	Dist	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.4	61	55.7	24.8	121	110.5	49.2	181	165.4	73.6	241	220.2	98.0
2	01.8	00.8	62	56.6	25.2	22	111.5	49.6	82	166.3	74.0	42	221.1	98.4
3	02.7	01.2	63	57.6	25.6	23	112.4	50.0	83	167.2	74.4	43	222.0	98.8
4	03.7	01.6	64	58.5	26.0	24	113.3	50.4	84	168.1	74.8	44	222.9	99.2
5	04.6	02.0	65	59.4	26.4	25	114.2	50.8	85	169.0	75.2	45	223.8	99.7
6	05.5	02.4	66	60.3	26.8	26	115.1	51.2	86	169.9	75.7	46	224.7	100.1
7	06.4	02.8	67	61.2	27.3	27	116.0	51.7	87	170.8	76.1	47	225.6	100.5
8	07.3	03.3	68	62.1	27.7	28	116.9	52.1	88	171.7	76.5	48	226.6	100.9
9	08.2	03.7	69	63.0	28.1	29	117.8	52.5	89	172.7	76.9	49	227.5	101.3
10	09.1	04.1	70	63.9	28.5	30	118.8	52.9	90	173.6	77.3	50	228.4	101.7
11	10.0	04.5	71	64.9	28.9	131	119.7	53.3	191	174.5	77.7	251	229.3	102.1
12	11.0	04.9	72	65.8	29.3	32	120.6	53.7	92	175.4	78.1	52	230.2	102.5
13	11.9	05.3	73	66.7	29.7	33	121.5	54.1	93	176.3	78.5	53	231.1	102.9
14	12.8	05.7	74	67.6	30.1	34	122.4	54.5	94	177.2	78.9	54	232.0	103.3
15	13.7	06.1	75	68.5	30.5	35	123.3	54.9	95	178.1	79.3	55	233.0	103.7
16	14.6	06.5	76	69.4	30.9	36	124.2	55.3	96	179.1	79.7	56	233.9	104.1
17	15.5	06.9	77	70.3	31.3	37	125.2	55.7	97	180.0	80.1	57	234.8	104.5
18	16.4	07.3	78	71.3	31.7	38	126.1	56.1	98	180.9	80.5	58	235.7	104.9
19	17.4	07.7	79	72.2	32.1	39	127.0	56.5	99	181.8	80.9	59	236.6	105.3
20	18.3	08.1	80	73.1	32.5	40	127.9	56.9	200	182.7	81.3	60	237.5	105.8
21	19.2	08.5	81	74.0	32.9	141	128.8	57.3	201	183.6	81.8	261	238.4	106.2
22	20.1	08.9	82	74.9	33.4	42	129.7	57.8	02	184.5	82.2	62	239.3	106.6
23	21.0	09.4	83	75.8	33.8	43	130.6	58.2	03	185.4	82.6	63	240.3	107.0
24	21.9	09.8	84	76.7	34.2	44	131.6	58.6	04	186.4	83.0	64	241.2	107.4
25	22.8	10.2	85	77.7	34.6	45	132.5	59.0	05	187.3	83.4	65	242.1	107.8
26	23.8	10.6	86	78.6	35.0	46	133.4	59.4	06	188.2	83.8	66	243.0	108.2
27	24.7	11.0	87	79.5	35.4	47	134.3	59.8	07	189.1	84.2	67	243.9	108.6
28	25.6	11.4	88	80.4	35.8	48	135.2	60.2	08	190.0	84.6	68	244.8	109.0
29	26.5	11.8	89	81.3	36.2	49	136.1	60.6	09	190.9	85.0	69	245.7	109.4
30	27.4	12.2	90	82.2	36.6	50	137.0	61.0	10	191.8	85.4	70	246.7	109.8
31	28.3	12.6	91	83.1	37.0	151	137.9	61.4	211	192.8	85.8	271	247.6	110.2
32	29.2	13.0	92	84.0	37.4	52	138.9	61.8	12	193.7	86.2	72	248.5	110.6
33	30.1	13.4	93	85.0	37.8	53	139.8	62.2	13	194.6	86.6	73	249.4	111.0
34	31.1	13.8	94	85.9	38.2	54	140.7	62.6	14	195.5	87.0	74	250.3	111.4
35	32.0	14.2	95	86.8	38.6	55	141.6	63.0	15	196.4	87.4	75	251.2	111.9
36	32.9	14.6	96	87.7	39.0	56	142.5	63.5	16	197.3	87.9	76	252.1	112.3
37	33.8	15.0	97	88.6	39.5	57	143.4	63.9	17	198.2	88.3	77	253.1	112.7
38	34.7	15.5	98	89.5	39.9	58	144.3	64.3	18	199.2	88.7	78	254.0	113.1
39	35.6	15.9	99	90.4	40.3	59	145.3	64.7	19	200.1	89.1	79	254.9	113.5
40	36.5	16.3	100	91.4	40.7	60	146.2	65.1	20	201.0	89.5	80	255.8	113.9
41	37.5	16.7	101	92.3	41.1	161	147.1	65.5	221	201.9	89.9	281	256.7	114.3
42	38.4	17.1	02	93.2	41.5	62	148.0	65.9	22	202.8	90.3	82	257.6	114.7
43	39.3	17.5	03	94.1	41.9	63	148.9	66.3	23	203.7	90.7	83	258.5	115.1
44	40.2	17.9	04	95.0	42.3	64	149.8	66.7	24	204.6	91.1	84	259.4	115.5
45	41.1	18.3	05	95.9	42.7	65	150.7	67.1	25	205.5	91.5	85	260.4	115.9
46	42.0	18.7	06	96.8	43.1	66	151.6	67.5	26	206.5	91.9	86	261.3	116.3
47	42.9	19.1	07	97.7	43.5	67	152.6	67.9	27	207.4	92.3	87	262.2	116.7
48	43.9	19.5	08	98.7	43.9	68	153.5	68.3	28	208.3	92.7	88	263.1	117.1
49	44.8	19.9	09	99.6	44.3	69	154.4	68.7	29	209.2	93.1	89	264.0	117.5
50	45.7	20.3	10	100.5	44.7	70	155.3	69.1	30	210.1	93.5	90	264.9	118.0
51	46.6	20.7	111	101.4	45.1	171	156.2	69.6	231	211.0	94.0	291	265.8	118.4
52	47.5	21.2	12	102.3	45.6	72	157.1	70.0	32	211.9	94.4	92	266.8	118.8
53	48.4	21.6	13	103.2	46.0	73	158.0	70.4	33	212.9	94.8	93	267.7	119.2
54	49.3	22.0	14	104.1	46.4	74	159.0	70.8	34	213.8	95.2	94	268.6	119.6
55	50.2	22.4	15	105.1	46.8	75	159.9	71.2	35	214.7	95.6	95	269.5	120.0
56	51.2	22.8	16	106.0	47.2	76	160.8	71.6	36	215.6	96.0	96	270.4	120.4
57	52.1	23.2	17	106.9	47.6	77	161.7	72.0	37	216.5	96.4	97	271.3	120.8
58	53.0	23.6	18	107.8	48.0	78	162.6	72.4	38	217.4	96.8	98	272.2	121.2
59	53.9	24.0	19	108.7	48.4	79	163.5	72.8	39	218.3	97.2	99	273.2	121.6
60	54.8	24.4	20	109.6	48.8	80	164.4	73.2	40	219.2	97.6	300	274.1	122.0
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 66 Degrees.

TABLE II. Difference of Latitude and Departure for 23 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.4	61	56.2	23.8	121	111.4	47.3	181	166.6	70.7	241	221.8	94.2
2	01.8	00.8	62	57.1	24.2	22	112.3	47.7	82	167.5	71.1	42	222.8	94.5
3	02.8	01.2	63	58.0	24.6	23	113.2	48.1	83	168.5	71.5	43	223.7	94.9
4	03.7	01.6	64	58.9	25.0	24	114.1	48.5	84	169.4	71.9	44	224.6	95.3
5	04.6	02.0	65	59.8	25.4	25	115.1	48.8	85	170.3	72.3	45	225.5	95.7
6	05.5	02.3	66	60.8	25.8	26	116.0	49.2	86	171.2	72.7	46	226.4	96.1
7	06.4	02.7	67	61.7	26.2	27	116.9	49.6	87	172.1	73.1	47	227.4	96.5
8	07.4	03.1	68	62.6	26.6	28	117.8	50.0	88	173.1	73.5	48	228.3	96.9
9	08.3	03.5	69	63.5	27.0	29	118.7	50.4	89	174.0	73.8	49	229.2	97.3
10	09.2	03.9	70	64.4	27.4	30	119.7	50.8	90	174.9	74.2	50	230.1	97.7
11	10.1	04.3	71	65.4	27.7	131	120.6	51.2	191	175.8	74.6	251	231.0	98.1
12	11.0	04.7	72	66.3	28.1	32	121.5	51.6	92	176.7	75.0	52	232.0	98.5
13	12.0	05.1	73	67.2	28.5	33	122.4	52.0	93	177.7	75.4	53	232.9	98.9
14	12.9	05.5	74	68.1	28.9	34	123.3	52.4	94	178.6	75.8	54	233.8	99.2
15	13.8	05.9	75	69.0	29.3	35	124.3	52.7	95	179.5	76.2	55	234.7	99.6
16	14.7	06.3	76	70.0	29.7	36	125.2	53.1	96	180.4	76.6	56	235.6	100.0
17	15.6	06.6	77	70.9	30.1	37	126.1	53.5	97	181.3	77.0	57	236.6	100.4
18	16.6	07.0	78	71.8	30.5	38	127.0	53.9	98	182.3	77.4	58	237.5	100.8
19	17.5	07.4	79	72.7	30.9	39	128.0	54.3	99	183.2	77.8	59	238.4	101.2
20	18.4	07.8	80	73.6	31.3	40	128.9	54.7	200	184.1	78.1	60	239.3	101.6
21	19.3	08.2	81	74.6	31.6	141	129.8	55.1	201	185.0	78.5	261	240.3	102.0
22	20.3	08.6	82	75.5	32.0	42	130.7	55.5	02	185.9	78.9	62	241.2	102.4
23	21.2	09.0	83	76.4	32.4	43	131.6	55.9	03	186.9	79.3	63	242.1	102.8
24	22.1	09.4	84	77.3	32.8	44	132.6	56.3	04	187.8	79.7	64	243.0	103.2
25	23.0	09.8	85	78.2	33.2	45	133.5	56.7	05	188.7	80.1	65	243.9	103.5
26	23.9	10.2	86	79.2	33.6	46	134.4	57.0	06	189.6	80.5	66	214.9	103.9
27	24.9	10.5	87	80.1	34.0	47	135.3	57.4	07	190.5	80.9	67	245.8	104.3
28	25.8	10.9	88	81.0	34.4	48	136.2	57.8	08	191.5	81.3	68	246.7	104.7
29	26.7	11.3	89	81.9	34.8	49	137.2	58.2	09	192.4	81.7	69	247.6	105.1
30	27.6	11.7	90	82.8	35.2	50	138.1	58.6	10	193.3	82.1	70	248.5	105.5
31	28.5	12.1	91	83.8	35.6	151	139.0	59.0	211	194.2	82.4	271	249.5	105.9
32	29.5	12.5	92	84.7	35.9	52	139.9	59.4	12	195.1	82.8	72	250.4	106.3
33	30.4	12.9	93	85.6	36.3	53	140.8	59.8	13	196.1	83.2	73	251.3	106.7
34	31.3	13.3	94	86.5	36.7	54	141.8	60.2	14	197.0	83.6	74	252.2	107.1
35	32.2	13.7	95	87.4	37.1	55	142.7	60.6	15	197.9	84.0	75	253.1	107.5
36	33.1	14.1	96	88.4	37.5	56	143.6	61.0	16	198.8	84.4	76	254.1	107.8
37	34.1	14.5	97	89.3	37.9	57	144.5	61.3	17	199.7	84.8	77	255.0	108.2
38	35.0	14.8	98	90.2	38.3	58	145.4	61.7	18	200.7	85.2	78	255.9	108.6
39	35.9	15.2	99	91.1	38.7	59	146.4	62.1	19	201.6	85.6	79	256.8	109.0
40	36.8	15.6	100	92.1	39.1	60	147.3	62.5	20	202.5	86.0	80	257.7	109.4
41	37.7	16.0	101	93.0	39.5	161	148.2	62.9	221	203.4	86.4	281	258.7	109.8
42	38.7	16.4	02	93.9	39.9	62	149.1	63.3	22	204.4	86.7	82	259.6	110.2
43	39.6	16.8	03	94.8	40.2	63	150.0	63.7	23	205.3	87.1	83	260.5	110.6
44	40.5	17.2	04	95.7	40.6	64	151.0	64.1	24	206.2	87.5	84	261.4	111.0
45	41.4	17.6	05	96.7	41.0	65	151.9	64.5	25	207.1	87.9	85	262.3	111.4
46	42.3	18.0	06	97.6	41.4	66	152.8	64.9	26	208.0	88.3	86	263.3	111.7
47	43.3	18.4	07	98.5	41.8	67	153.7	65.3	27	209.0	88.7	87	264.2	112.1
48	44.2	18.8	08	99.4	42.2	68	154.6	65.6	28	209.9	89.1	88	265.1	112.5
49	45.1	19.1	09	100.3	42.6	69	155.6	66.0	29	210.8	89.5	89	266.0	112.9
50	46.0	19.5	10	101.3	43.0	70	156.5	66.4	30	211.7	89.9	90	266.9	113.3
51	46.9	19.9	111	102.2	43.4	171	157.4	66.8	231	212.6	90.3	291	267.9	113.7
52	47.9	20.3	12	103.1	43.8	72	158.3	67.2	32	213.6	90.6	92	268.8	114.1
53	48.8	20.7	13	104.0	44.2	73	159.2	67.6	33	214.5	91.0	93	269.7	114.5
54	49.7	21.1	14	104.9	44.5	74	160.2	68.0	34	215.4	91.4	94	270.6	114.9
55	50.6	21.5	15	105.9	44.9	75	161.1	68.4	35	216.3	91.8	95	271.5	115.3
56	51.5	21.9	16	106.8	45.3	76	162.0	68.8	36	217.2	92.2	96	272.5	115.7
57	52.5	22.3	17	107.7	45.7	77	162.9	69.2	37	218.2	92.6	97	273.4	116.0
58	53.4	22.7	18	108.6	46.1	78	163.8	69.6	38	219.1	93.0	98	274.3	116.4
59	54.3	23.1	19	109.5	46.5	79	164.8	69.9	39	220.0	93.4	99	275.2	116.8
60	55.2	23.4	20	110.5	46.9	80	165.7	70.3	40	220.9	93.8	300	276.2	117.2
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 67 Degrees.

Difference of Latitude and Departure for 26 Degrees.

st.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
61	54.8	26.7	121	108.8	53.0	181	162.7	79.3	241	216.6	105.6
62	55.7	27.2	22	109.7	53.5	82	163.6	79.8	42	217.5	106.1
63	56.6	27.6	23	110.6	53.9	83	164.5	80.2	43	218.4	106.5
64	57.5	28.1	24	111.5	54.4	84	165.4	80.7	44	219.3	107.0
65	58.4	28.5	25	112.3	54.8	85	166.3	81.1	45	220.2	107.4
66	59.3	28.9	26	113.2	55.2	86	167.2	81.5	46	221.1	107.8
67	60.2	29.4	27	114.1	55.7	87	168.1	82.0	47	222.0	108.3
68	61.1	29.8	28	115.0	56.1	88	169.0	82.4	48	222.9	108.7
69	62.0	30.2	29	115.9	56.5	89	169.9	82.9	49	223.8	109.2
70	62.9	30.7	30	116.8	57.0	90	170.8	83.3	50	224.7	109.6
71	63.8	31.1	131	117.7	57.4	191	171.7	83.7	251	225.6	110.0
72	64.7	31.6	32	118.6	57.9	92	172.6	84.2	52	226.5	110.5
73	65.6	32.0	33	119.5	58.3	93	173.5	84.6	53	227.4	110.9
74	66.5	32.4	34	120.4	58.7	94	174.4	85.0	54	228.3	111.3
75	67.4	32.9	35	121.3	59.2	95	175.3	85.5	55	229.2	111.8
76	68.3	33.3	36	122.2	59.6	96	176.2	85.9	56	230.1	112.2
77	69.2	33.8	37	123.1	60.1	97	177.1	86.4	57	231.0	112.7
78	70.1	34.2	38	124.0	60.5	98	178.0	86.8	58	231.9	113.1
79	71.0	34.6	39	124.9	60.9	99	178.9	87.2	59	232.8	113.5
80	71.9	35.1	40	125.8	61.4	200	179.8	87.7	60	233.7	114.0
81	72.8	35.5	141	126.7	61.8	201	180.7	88.1	261	234.6	114.4
82	73.7	35.9	42	127.6	62.2	02	181.6	88.6	62	235.5	114.9
83	74.6	36.4	43	128.5	62.7	03	182.5	89.0	63	236.4	115.3
84	75.5	36.8	44	129.4	63.1	04	183.4	89.4	64	237.3	115.7
85	76.4	37.3	45	130.3	63.6	05	184.3	89.9	65	238.2	116.2
86	77.3	37.7	46	131.2	64.0	06	185.2	90.3	66	239.1	116.6
87	78.2	38.1	47	132.1	64.4	07	186.1	90.7	67	240.0	117.0
88	79.1	38.6	48	133.0	64.9	08	186.9	91.2	68	240.9	117.5
89	80.0	39.0	49	133.9	65.3	09	187.8	91.6	69	241.8	117.9
90	80.9	39.5	50	134.8	65.8	10	188.7	92.1	70	242.7	118.4
91	81.8	39.9	151	135.7	66.2	211	189.6	92.5	271	243.6	118.8
92	82.7	40.3	52	136.6	66.6	12	190.5	92.9	72	244.5	119.2

TABLE II. Difference of Latitude and Departure for 25 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.4	61	55.3	25.8	121	109.7	51.1	181	164.0	76.5	241	218.4	101.9
2	01.8	00.8	62	56.2	26.2	22	110.6	51.6	82	164.9	76.9	42	219.3	102.3
3	02.7	01.3	63	57.1	26.6	23	111.5	52.0	83	165.9	77.3	43	220.2	102.7
4	03.6	01.7	64	58.0	27.0	24	112.4	52.4	84	166.8	77.8	44	221.1	103.1
5	04.5	02.1	65	58.9	27.5	25	113.3	52.8	85	167.7	78.2	45	222.0	103.5
6	05.4	02.5	66	59.8	27.9	26	114.2	53.2	86	168.6	78.6	46	223.0	104.0
7	06.3	03.0	67	60.7	28.3	27	115.1	53.7	87	169.5	79.0	47	223.9	104.4
8	07.3	03.4	68	61.6	28.7	28	116.0	54.1	88	170.4	79.5	48	224.8	104.8
9	08.2	03.8	69	62.5	29.2	29	116.9	54.5	89	171.3	79.9	49	225.7	105.2
10	09.1	04.2	70	63.4	29.6	30	117.8	54.9	90	172.2	80.3	50	226.6	105.7
11	10.0	04.6	71	64.3	30.0	131	118.7	55.4	191	173.1	80.7	251	227.5	106.1
12	10.9	05.1	72	65.3	30.4	32	119.6	55.8	92	174.0	81.1	52	228.4	106.5
13	11.8	05.5	73	66.2	30.9	33	120.5	56.2	93	174.9	81.6	53	229.3	106.9
14	12.7	05.9	74	67.1	31.3	34	121.4	56.6	94	175.8	82.0	54	230.2	107.3
15	13.6	06.3	75	68.0	31.7	35	122.4	57.1	95	176.7	82.4	55	231.1	107.8
16	14.5	06.8	76	68.9	32.1	36	123.3	57.5	96	177.6	82.8	56	232.0	108.2
17	15.4	07.2	77	69.8	32.5	37	124.2	57.9	97	178.5	83.3	57	232.9	108.6
18	16.3	07.6	78	70.7	33.0	38	125.1	58.3	98	179.4	83.7	58	233.8	109.0
19	17.2	08.0	79	71.6	33.4	39	126.0	58.7	99	180.4	84.1	59	234.7	109.5
20	18.1	08.5	80	72.5	33.8	40	126.9	59.2	200	181.3	84.5	60	235.6	109.9
21	19.0	08.9	81	73.4	34.2	141	127.8	59.6	201	182.2	84.9	261	236.5	110.3
22	19.9	09.3	82	74.3	34.7	42	128.7	60.0	02	183.1	85.4	62	237.5	110.7
23	20.8	09.7	83	75.2	35.1	43	129.6	60.4	03	184.0	85.8	63	238.4	111.1
24	21.8	10.1	84	76.1	35.5	44	130.5	60.9	04	184.9	86.2	64	239.3	111.6
25	22.7	10.6	85	77.0	35.9	45	131.4	61.3	05	185.8	86.6	65	240.2	112.0
26	23.6	11.0	86	77.9	36.3	46	132.3	61.7	06	186.7	87.1	66	241.1	112.4
27	24.5	11.4	87	78.8	36.8	47	133.2	62.1	07	187.6	87.5	67	242.0	112.8
28	25.4	11.8	88	79.8	37.2	48	134.1	62.5	08	188.5	87.9	68	242.9	113.3
29	26.3	12.3	89	80.7	37.6	49	135.0	63.0	09	189.4	88.3	69	243.8	113.7
30	27.2	12.7	90	81.6	38.0	50	135.9	63.4	10	190.3	88.7	70	244.7	114.1
31	28.1	13.1	91	82.5	38.5	151	136.9	63.8	211	191.2	89.2	271	245.6	114.5
32	29.0	13.5	92	83.4	38.9	52	137.8	64.2	12	192.1	89.6	72	246.5	115.0
33	29.9	13.9	93	84.3	39.3	53	138.7	64.7	13	193.0	90.0	73	247.4	115.4
34	30.8	14.4	94	85.2	39.7	54	139.6	65.1	14	193.9	90.4	74	248.3	115.8
35	31.7	14.8	95	86.1	40.1	55	140.5	65.5	15	194.9	90.9	75	249.2	116.2
36	32.6	15.2	96	87.0	40.6	56	141.4	65.9	16	195.8	91.3	76	250.1	116.6
37	33.5	15.6	97	87.9	41.0	57	142.3	66.4	17	196.7	91.7	77	251.0	117.1
38	34.4	16.1	98	88.8	41.4	58	143.2	66.8	18	197.6	92.1	78	252.0	117.5
39	35.3	16.5	99	89.7	41.8	59	144.1	67.2	19	198.5	92.6	79	252.9	117.9
40	36.3	16.9	100	90.6	42.3	60	145.0	67.6	20	199.4	93.0	80	253.8	118.3
41	37.2	17.3	101	91.5	42.7	161	145.9	68.0	221	200.3	93.4	281	254.7	118.8
42	38.1	17.7	02	92.4	43.1	62	146.8	68.5	22	201.2	93.8	82	255.6	119.2
43	39.0	18.2	03	93.3	43.5	63	147.7	68.9	23	202.1	94.2	83	256.5	119.6
44	39.9	18.6	04	94.3	44.0	64	148.6	69.3	24	203.0	94.7	84	257.4	120.0
45	40.8	19.0	05	95.2	44.4	65	149.5	69.7	25	203.9	95.1	85	258.3	120.4
46	41.7	19.4	06	96.1	44.8	66	150.4	70.2	26	204.8	95.5	86	259.2	120.9
47	42.6	19.9	07	97.0	45.2	67	151.4	70.6	27	205.7	95.9	87	260.1	121.3
48	43.5	20.3	08	97.9	45.6	68	152.3	71.0	28	206.6	96.4	88	261.0	121.7
49	44.4	20.7	09	98.8	46.1	69	153.2	71.4	29	207.5	96.8	89	261.9	122.1
50	45.3	21.1	10	99.7	46.5	70	154.1	71.8	30	208.5	97.2	90	262.8	122.6
51	46.2	21.6	111	100.6	46.9	171	155.0	72.3	231	209.4	97.6	291	263.7	123.0
52	47.1	22.0	12	101.5	47.3	72	155.9	72.7	32	210.3	98.0	92	264.6	123.4
53	48.0	22.4	13	102.4	47.8	73	156.8	73.1	33	211.2	98.5	93	265.5	123.8
54	48.9	22.8	14	103.3	48.2	74	157.7	73.5	34	212.1	98.9	94	266.5	124.2
55	49.8	23.2	15	104.2	48.6	75	158.6	74.0	35	213.0	99.3	95	267.4	124.7
56	50.8	23.7	16	105.1	49.0	76	159.5	74.4	36	213.9	99.7	96	268.3	125.1
57	51.7	24.1	17	106.0	49.4	77	160.4	74.8	37	214.8	100.2	97	269.2	125.5
58	52.6	24.5	18	106.9	49.9	78	161.3	75.2	38	215.7	100.6	98	270.1	125.9
59	53.5	24.9	19	107.9	50.3	79	162.2	75.6	39	216.6	101.0	99	271.0	126.4
60	54.4	25.4	20	108.8	50.7	80	163.1	76.1	40	217.5	101.4	300	271.9	126.8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 65 Degrees.

ist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist	Lat.	Dep.
61	53.9	28.6	121	106.8	56.8	181	159.8	85.0	241	212.8	113.1
62	54.7	29.1	22	107.7	57.3	82	160.7	85.4	42	213.7	113.6
63	55.6	29.6	23	108.6	57.7	83	161.6	85.9	43	214.6	114.1
64	56.5	30.0	24	109.5	58.2	84	162.5	86.4	44	215.4	114.6
65	57.4	30.5	25	110.4	58.7	85	163.3	86.9	45	216.3	115.0
66	58.3	31.0	26	111.3	59.2	86	164.2	87.3	46	217.2	115.5
67	59.2	31.5	27	112.1	59.6	87	165.1	87.8	47	218.1	116.0
68	60.0	31.9	28	113.0	60.1	88	166.0	88.3	48	219.0	116.4
69	60.9	32.4	29	113.9	60.6	89	166.9	88.7	49	219.9	116.9
70	61.8	32.9	30	114.8	61.0	90	167.8	89.2	50	220.7	117.4
71	62.7	33.3	131	115.7	61.5	191	168.6	89.7	251	221.6	117.8
72	63.6	33.8	32	116.5	62.0	92	169.5	90.1	52	222.5	118.3
73	64.5	34.3	33	117.4	62.4	93	170.4	90.6	53	223.4	118.8
74	65.3	34.7	34	118.3	62.9	94	171.3	91.1	54	224.3	119.2
75	66.2	35.2	35	119.2	63.4	95	172.2	91.5	55	225.2	119.7
76	67.1	35.7	36	120.1	63.8	96	173.1	92.0	56	226.0	120.2
77	68.0	36.1	37	121.0	64.3	97	173.9	92.5	57	226.9	120.7
78	68.9	36.6	38	121.8	64.8	98	174.8	93.0	58	227.8	121.1
79	69.8	37.1	39	122.7	65.3	99	175.7	93.4	59	228.7	121.6
80	70.6	37.6	40	123.6	65.7	200	176.6	93.9	60	229.6	122.1
81	71.5	38.0	141	124.5	66.2	201	177.5	94.4	261	230.4	122.5
82	72.4	38.5	42	125.4	66.7	02	178.4	94.8	62	231.3	123.0
83	73.3	39.0	43	126.3	67.1	03	179.2	95.3	63	232.2	123.5
84	74.2	39.4	44	127.1	67.6	04	180.1	95.8	64	233.1	123.9
85	75.1	39.9	45	128.0	68.1	05	181.0	96.2	65	234.0	124.4
86	75.9	40.4	46	128.9	68.5	06	181.9	96.7	66	234.9	124.9
87	76.8	40.8	47	129.8	69.0	07	182.8	97.2	67	235.7	125.3
88	77.7	41.3	48	130.7	69.5	08	183.7	97.7	68	236.6	125.8
89	78.6	41.8	49	131.6	70.0	09	184.5	98.1	69	237.5	126.3
90	79.5	42.3	50	132.4	70.4	10	185.4	98.6	70	238.4	126.8
91	80.3	42.7	151	133.3	70.9	211	186.3	99.1	271	239.3	127.2
92	81.2	43.2	52	134.2	71.4	12	187.2	99.5	72	240.2	127.7

TABLE II. Difference of Latitude and Departure for 27 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.5	61	54.4	27.7	121	107.8	54.9	181	161.3	82.2	241	214.7	109.4
2	01.8	00.9	62	55.2	28.1	22	108.7	55.4	82	162.2	82.6	42	215.6	109.9
3	02.7	01.4	63	56.1	28.6	23	109.6	55.8	83	163.1	83.1	43	216.5	110.3
4	03.6	01.8	64	57.0	29.1	24	110.5	56.3	84	163.9	83.5	44	217.4	110.8
5	04.5	02.3	65	57.9	29.5	25	111.4	56.7	85	164.8	84.0	45	218.3	111.2
6	05.3	02.7	66	58.8	30.0	26	112.3	57.2	86	165.7	84.4	46	219.2	111.7
7	06.2	03.2	67	59.7	30.4	27	113.2	57.7	87	166.6	84.9	47	220.1	112.1
8	07.1	03.6	68	60.6	30.9	28	114.0	58.1	88	167.5	85.4	48	221.0	112.6
9	08.0	04.1	69	61.5	31.3	29	114.9	58.6	89	168.4	85.8	49	221.9	113.0
10	08.9	04.5	70	62.4	31.8	30	115.8	59.0	90	169.3	86.3	50	222.8	113.5
11	09.8	05.0	71	63.3	32.2	131	116.7	59.5	191	170.2	86.7	251	223.6	114.0
12	10.7	05.4	72	64.2	32.7	32	117.6	59.9	92	171.1	87.2	52	224.5	114.4
13	11.6	05.9	73	65.0	33.1	33	118.5	60.4	93	172.0	87.6	53	225.4	114.9
14	12.5	06.4	74	65.9	33.6	34	119.4	60.8	94	172.9	88.1	54	226.3	115.3
15	13.4	06.8	75	66.8	34.0	35	120.3	61.3	95	173.7	88.5	55	227.2	115.8
16	14.3	07.3	76	67.7	34.5	36	121.2	61.7	96	174.6	89.0	56	228.1	116.2
17	15.1	07.7	77	68.6	35.0	37	122.1	62.2	97	175.5	89.4	57	229.0	116.7
18	16.0	08.2	78	69.5	35.4	38	123.0	62.7	98	176.4	89.9	58	229.9	117.1
19	16.9	08.6	79	70.4	35.9	39	123.8	63.1	99	177.3	90.3	59	230.8	117.6
20	17.8	09.1	80	71.3	36.3	40	124.7	63.6	200	178.2	90.8	60	231.7	118.0
21	18.7	09.5	81	72.2	36.8	141	125.6	64.0	201	179.1	91.3	261	232.6	118.5
22	19.6	10.0	82	73.1	37.2	42	126.5	64.5	02	180.0	91.7	62	233.4	118.9
23	20.5	10.4	83	74.0	37.7	43	127.4	64.9	03	180.9	92.2	63	234.3	119.4
24	21.4	10.9	84	74.8	38.1	44	128.3	65.4	04	181.8	92.6	64	235.2	119.9
25	22.3	11.3	85	75.7	38.6	45	129.2	65.8	05	182.7	93.1	65	236.1	120.3
26	23.2	11.8	86	76.6	39.0	46	130.1	66.3	06	183.5	93.5	66	237.0	120.8
27	24.1	12.3	87	77.5	39.5	47	131.0	66.7	07	184.4	94.0	67	237.9	121.2
28	24.9	12.7	88	78.4	40.0	48	131.9	67.2	08	185.3	94.4	68	238.8	121.7
29	25.8	13.2	89	79.3	40.4	49	132.8	67.6	09	186.2	94.9	69	239.7	122.1
30	26.7	13.6	90	80.2	40.9	50	133.7	68.1	10	187.1	95.3	70	240.6	122.6
31	27.6	14.1	91	81.1	41.3	151	134.5	68.6	211	188.0	95.8	271	241.5	123.0
32	28.5	14.5	92	82.0	41.8	52	135.4	69.0	12	188.9	96.2	72	242.4	123.5
33	29.4	15.0	93	82.9	42.2	53	136.3	69.5	13	189.8	96.7	73	243.2	123.9
34	30.3	15.4	94	83.8	42.7	54	137.2	69.9	14	190.7	97.2	74	244.1	124.4
35	31.2	15.9	95	84.6	43.1	55	138.1	70.4	15	191.6	97.6	75	245.0	124.8
36	32.1	16.3	96	85.5	43.6	56	139.0	70.8	16	192.5	98.1	76	245.9	125.3
37	33.0	16.8	97	86.4	44.0	57	139.9	71.3	17	193.3	98.5	77	246.8	125.8
38	33.9	17.3	98	87.3	44.5	58	140.8	71.7	18	194.2	99.0	78	247.7	126.2
39	34.7	17.7	99	88.2	44.9	59	141.7	72.2	19	195.1	99.4	79	248.6	126.7
40	35.6	18.2	100	89.1	45.4	60	142.6	72.6	20	196.0	99.9	80	249.5	127.1
41	36.5	18.6	101	90.0	45.9	161	143.5	73.1	221	196.9	100.3	281	250.4	127.6
42	37.4	19.1	02	90.9	46.3	62	144.3	73.5	22	197.8	100.8	82	251.3	128.0
43	38.3	19.5	03	91.8	46.8	63	145.2	74.0	23	198.7	101.2	83	252.2	128.5
44	39.2	20.0	04	92.7	47.2	64	146.1	74.5	24	199.6	101.7	84	253.0	128.9
45	40.1	20.4	05	93.6	47.7	65	147.0	74.9	25	200.5	102.1	85	253.9	129.4
46	41.0	20.9	06	94.4	48.1	66	147.9	75.4	26	201.4	102.6	86	254.8	129.8
47	41.9	21.3	07	95.3	48.6	67	148.8	75.8	27	202.3	103.1	87	255.7	130.3
48	42.8	21.8	08	96.2	49.0	68	149.7	76.3	28	203.1	103.5	88	256.6	130.7
49	43.7	22.2	09	97.1	49.5	69	150.6	76.7	29	204.0	104.0	89	257.5	131.2
50	44.6	22.7	10	98.0	49.9	70	151.5	77.2	30	204.9	104.4	90	258.4	131.7
51	45.4	23.2	111	98.9	50.4	171	152.4	77.6	231	205.8	104.9	291	259.3	132.1
52	46.3	23.6	12	99.8	50.8	72	153.3	78.1	32	206.7	105.3	92	260.2	132.6
53	47.2	24.1	13	100.7	51.3	73	154.1	78.5	33	207.6	105.8	93	261.1	133.0
54	48.1	24.5	14	101.6	51.8	74	155.0	79.0	34	208.5	106.2	94	262.0	133.5
55	49.0	25.0	15	102.5	52.2	75	155.9	79.4	35	209.4	106.7	95	262.8	133.9
56	49.9	25.4	16	103.4	52.7	76	156.8	79.9	36	210.3	107.1	96	263.7	134.4
57	50.8	25.9	17	104.2	53.1	77	157.7	80.4	37	211.2	107.6	97	264.6	134.8
58	51.7	26.3	18	105.1	53.6	78	158.6	80.8	38	212.1	108.0	98	265.5	135.3
59	52.6	26.8	19	106.0	54.0	79	159.5	81.3	39	213.0	108.5	99	266.4	135.7
60	53.5	27.2	20	106.9	54.5	80	160.4	81.7	40	213.8	109.0	300	267.3	136.2
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 63 Degrees.

st.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	52.8	30.5	121	104.8	60.5	181	156.8	90.5	241	208.7	120.5
2	53.7	31.0	22	105.7	61.0	82	157.6	91.0	42	209.6	121.0
3	54.6	31.5	23	106.5	61.5	83	158.5	91.5	42	210.4	121.5
4	55.4	32.0	24	107.4	62.0	84	159.3	92.0	44	211.3	122.0
5	56.3	32.5	25	108.3	62.5	85	160.2	92.5	45	212.2	122.5
6	57.2	33.0	26	109.1	63.0	86	161.1	93.0	46	213.0	123.0
7	58.0	33.5	27	110.0	63.5	87	161.9	93.5	47	213.9	123.5
8	58.9	34.0	28	110.9	64.0	88	162.8	94.0	48	214.8	124.0
9	59.8	34.5	29	111.7	64.5	89	163.7	94.5	49	215.6	124.5
0	60.6	35.0	30	112.6	65.0	90	164.5	95.0	50	216.5	125.0
1	61.5	35.5	131	113.4	65.5	191	165.4	95.5	251	217.4	125.5
2	62.4	36.0	32	114.3	66.0	92	166.3	96.0	52	218.2	126.0
3	63.2	36.5	33	115.2	66.5	93	167.1	96.5	53	219.1	126.5
4	64.1	37.0	34	116.0	67.0	94	168.0	97.0	54	220.0	127.0
5	65.0	37.5	35	116.9	67.5	95	168.9	97.5	55	220.8	127.5
6	65.8	38.0	36	117.8	68.0	96	169.7	98.0	56	221.7	128.0
7	66.7	38.5	37	118.6	68.5	97	170.6	98.5	57	222.6	128.5
8	67.5	39.0	38	119.5	69.0	98	171.5	99.0	58	223.4	129.0
9	68.4	39.5	39	120.4	69.5	99	172.3	99.5	59	224.3	129.5
0	69.3	40.0	40	121.2	70.0	200	173.2	100.0	60	225.2	130.0
1	70.1	40.5	141	122.1	70.5	201	174.1	100.5	261	226.0	130.5
2	71.0	41.0	42	123.0	71.0	02	174.9	101.0	62	226.9	131.0
3	71.9	41.5	43	123.8	71.5	03	175.8	101.5	63	227.8	131.5
4	72.7	42.0	44	124.7	72.0	04	176.7	102.0	64	228.6	132.0
5	73.6	42.5	45	125.6	72.5	05	177.5	102.5	65	229.5	132.5
6	74.5	43.0	46	126.4	73.0	06	178.4	103.0	66	230.4	133.0
7	75.3	43.5	47	127.3	73.5	07	179.3	103.5	67	231.2	133.5
8	76.2	44.0	48	128.2	74.0	08	180.1	104.0	68	232.1	134.0
9	77.1	44.5	49	129.0	74.5	09	181.0	104.5	69	233.0	134.5
0	77.9	45.0	50	129.9	75.0	10	181.9	105.0	70	233.8	135.0
1	78.8	45.5	151	130.8	75.5	211	182.7	105.5	271	234.7	135.5
2	79.7	46.0	52	131.6	76.0	12	183.6	106.0	72	235.6	136.0
3	80.5	46.5	53	132.5	76.5	13	184.5	106.5	73	236.4	136.5

TABLE II. Difference of Latitude and Departure for 29 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.5	61	53.4	29.6	121	105.8	58.7	181	158.3	87.8	241	210.8	116.8
2	01.7	01.0	62	54.2	30.1	22	106.7	59.1	82	159.2	88.2	42	211.7	117.3
3	02.6	01.5	63	55.1	30.5	23	107.6	59.6	83	160.1	88.7	43	212.5	117.8
4	03.5	01.9	64	56.0	31.0	24	108.5	60.1	84	160.9	89.2	44	213.4	118.3
5	04.4	02.4	65	56.8	31.5	25	109.3	60.6	85	161.8	89.7	45	214.3	118.8
6	05.2	02.9	66	57.7	32.0	26	110.2	61.1	86	162.7	90.2	46	215.2	119.3
7	06.1	03.4	67	58.6	32.5	27	111.1	61.6	87	163.6	90.7	47	216.0	119.7
8	07.0	03.9	68	59.5	33.0	28	112.0	62.1	88	164.4	91.1	48	216.9	120.2
9	07.9	04.4	69	60.3	33.5	29	112.8	62.5	89	165.3	91.6	49	217.8	120.7
10	08.7	04.8	70	61.2	33.9	30	113.7	63.0	90	166.2	92.1	50	218.7	121.2
11	09.6	05.3	71	62.1	34.4	131	114.6	63.5	191	167.1	92.6	251	219.5	121.7
12	10.5	05.8	72	63.0	34.9	32	115.4	64.0	92	167.9	93.1	52	220.4	122.2
13	11.4	06.3	73	63.8	35.4	33	116.3	64.5	93	168.8	93.6	53	221.3	122.7
14	12.2	06.8	74	64.7	35.9	34	117.2	65.0	94	169.7	94.1	54	222.2	123.1
15	13.1	07.3	75	65.6	36.4	35	118.1	65.4	95	170.6	94.5	55	223.0	123.6
16	14.0	07.8	76	66.5	36.8	36	118.9	65.9	96	171.4	95.0	56	223.9	124.1
17	14.9	08.2	77	67.3	37.3	37	119.8	66.4	97	172.3	95.5	57	224.8	124.6
18	15.7	08.7	78	68.2	37.8	38	120.7	66.9	98	173.2	96.0	58	225.7	125.1
19	16.6	09.2	79	69.1	38.3	39	121.6	67.4	99	174.0	96.5	59	226.5	125.6
20	17.5	09.7	80	70.0	38.8	40	122.4	67.9	200	174.9	97.0	60	227.4	126.1
21	18.4	10.2	81	70.8	39.3	141	123.3	68.4	201	175.8	97.4	261	228.3	126.5
22	19.2	10.7	82	71.7	39.8	42	124.2	68.8	02	176.7	97.9	62	229.2	127.0
23	20.1	11.2	83	72.6	40.2	43	125.1	69.3	03	177.5	98.4	63	230.0	127.5
24	21.0	11.6	84	73.5	40.7	44	125.9	69.8	04	178.4	98.9	64	230.9	128.0
25	21.9	12.1	85	74.3	41.2	45	126.8	70.3	05	179.3	99.4	65	231.8	128.5
26	22.7	12.6	86	75.2	41.7	46	127.7	70.8	06	180.2	99.9	66	232.6	129.0
27	23.6	13.1	87	76.1	42.2	47	128.6	71.3	07	181.0	100.4	67	233.5	129.4
28	24.5	13.6	88	77.0	42.7	48	129.4	71.8	08	181.9	100.8	68	234.4	129.9
29	25.4	14.1	89	77.8	43.1	49	130.3	72.2	09	182.8	101.3	69	235.3	130.4
30	26.2	14.5	90	78.7	43.6	50	131.2	72.7	10	183.7	101.8	70	236.1	130.9
31	27.1	15.0	91	79.6	44.1	151	132.1	73.2	211	184.5	102.3	271	237.0	131.4
32	28.0	15.5	92	80.5	44.6	52	132.9	73.7	12	185.4	102.8	72	237.9	131.9
33	28.9	16.0	93	81.3	45.1	53	133.8	74.2	13	186.3	103.3	73	238.8	132.4
34	29.7	16.5	94	82.2	45.6	54	134.7	74.7	14	187.2	103.7	74	239.6	132.8
35	30.6	17.0	95	83.1	46.1	55	135.6	75.1	15	188.0	104.2	75	240.5	133.3
36	31.5	17.5	96	84.0	46.5	56	136.4	75.6	16	188.9	104.7	76	241.4	133.8
37	32.4	17.9	97	84.8	47.0	57	137.3	76.1	17	189.8	105.2	77	242.3	134.3
38	33.2	18.4	98	85.7	47.5	58	138.2	76.6	18	190.7	105.7	78	243.1	134.8
39	34.1	18.9	99	86.6	48.0	59	139.1	77.1	19	191.5	106.2	79	244.0	135.3
40	35.0	19.4	100	87.5	48.5	60	139.9	77.6	20	192.4	106.7	80	244.9	135.7
41	35.9	19.9	101	88.3	49.0	161	140.8	78.1	221	193.3	107.1	281	245.8	136.2
42	36.7	20.4	02	89.2	49.5	62	141.7	78.5	22	194.2	107.6	82	246.6	136.7
43	37.6	20.8	03	90.1	49.9	63	142.6	79.0	23	195.0	108.1	83	247.5	137.2
44	38.5	21.3	04	91.0	50.4	64	143.4	79.5	24	195.9	108.6	84	248.4	137.7
45	39.4	21.8	05	91.8	50.9	65	144.3	80.0	25	196.8	109.1	85	249.3	138.2
46	40.2	22.3	06	92.7	51.4	66	145.2	80.5	26	197.7	109.6	86	250.1	138.7
47	41.1	22.8	07	93.6	51.9	67	146.1	81.0	27	198.5	110.1	87	251.0	139.1
48	42.0	23.3	08	94.5	52.4	68	146.9	81.4	28	199.4	110.5	88	251.9	139.6
49	42.9	23.8	09	95.3	52.8	69	147.8	81.9	29	200.3	111.0	89	252.8	140.1
50	43.7	24.2	10	96.2	53.3	70	148.7	82.4	30	201.2	111.5	90	253.6	140.6
51	44.6	24.7	111	97.1	53.8	171	149.6	82.9	231	202.0	112.0	291	254.5	141.1
52	45.5	25.2	12	98.0	54.3	72	150.4	83.4	32	202.9	112.5	92	255.4	141.6
53	46.4	25.7	13	98.8	54.8	73	151.3	83.9	33	203.8	113.0	93	256.3	142.0
54	47.2	26.2	14	99.7	55.3	74	152.2	84.4	34	204.7	113.4	94	257.1	142.5
55	48.1	26.7	15	100.6	55.8	75	153.1	84.8	35	205.5	113.9	95	258.0	143.0
56	49.0	27.1	16	101.5	56.2	76	153.9	85.3	36	206.4	114.4	96	258.9	143.5
57	49.9	27.6	17	102.3	56.7	77	154.8	85.8	37	207.3	114.9	97	259.8	144.0
58	50.7	28.1	18	103.2	57.2	78	155.7	86.3	38	208.2	115.4	98	260.6	144.5
59	51.6	28.6	19	104.1	57.7	79	156.6	86.8	39	209.0	115.9	99	261.5	145.0
60	52.5	29.1	20	105.0	58.2	80	157.4	87.3	40	209.9	116.4	300	262.4	145.4
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 61 Degrees.

Difference of Latitude and Departure for 32 Degrees.

ist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
61	51.7	32.3	121	102.6	64.1	181	153.5	95.9	241	204.4	127.7
62	52.6	32.9	22	103.5	64.7	82	154.3	96.4	42	205.2	128.2
63	53.4	33.4	23	104.3	65.2	83	155.2	97.0	43	206.1	128.8
64	54.3	33.9	24	105.2	65.7	84	156.0	97.5	44	206.9	129.3
65	55.1	34.4	25	106.0	66.2	85	156.9	98.0	45	207.8	129.8
66	56.0	35.0	26	106.9	66.8	86	157.7	98.6	46	208.6	130.4
67	56.8	35.5	27	107.7	67.3	87	158.6	99.1	47	209.5	130.9
68	57.7	36.0	28	108.6	67.8	88	159.4	99.6	48	210.3	131.4
69	58.5	36.6	29	109.4	68.4	89	160.3	100.2	49	211.2	131.9
70	59.4	37.1	30	110.2	68.9	90	161.1	100.7	50	212.0	132.5
71	60.2	37.6	131	111.1	69.4	191	162.0	101.2	251	212.8	133.0
72	61.1	38.2	32	111.9	69.9	92	162.8	101.7	52	213.7	132.5
73	61.9	38.7	33	112.8	70.5	93	163.7	102.3	53	214.6	134.1
74	62.8	39.2	34	113.6	71.0	94	164.5	102.8	54	215.4	134.6
75	63.6	39.8	35	114.5	71.5	95	165.4	103.3	55	216.3	135.1
76	64.5	40.3	36	115.3	72.1	96	166.2	103.9	56	217.1	135.7
77	65.3	40.8	37	116.2	72.6	97	167.1	104.4	57	217.9	136.2
78	66.1	41.3	38	117.0	73.1	98	167.9	104.9	58	218.8	136.7
79	67.0	41.9	39	117.9	73.7	99	168.8	105.5	59	219.6	137.2
80	67.8	42.4	40	118.8	74.2	200	169.6	106.0	60	220.5	137.8
81	68.7	42.9	141	119.6	74.7	201	170.5	106.5	261	221.3	138.3
82	69.5	43.5	42	120.4	75.2	02	171.3	107.0	62	222.2	138.8
83	70.4	44.0	43	121.3	75.8	03	172.2	107.6	63	223.0	139.4
84	71.2	44.5	44	122.1	76.3	04	173.0	108.1	64	223.9	139.9
85	72.1	45.0	45	123.0	76.8	05	173.8	108.6	65	224.7	140.4
86	72.9	45.6	46	123.8	77.4	06	174.7	109.2	66	225.6	141.0
87	73.8	46.1	47	124.7	77.9	07	175.5	109.7	67	226.4	141.5
88	74.6	46.6	48	125.5	78.4	08	176.4	110.2	68	227.3	142.0
89	75.5	47.2	49	126.4	79.0	09	177.2	110.8	69	228.1	142.5
90	76.3	47.7	50	127.2	79.5	10	178.1	111.3	70	229.0	143.1
91	77.2	48.2	151	128.1	80.0	211	178.9	111.8	271	229.8	143.6
92	78.0	48.8	52	128.9	80.5	12	179.8	112.3	72	230.7	144.1

TABLE II. Difference of Latitude and Departure for 31 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.5	61	52.3	31.4	121	103.7	62.3	181	155.1	93.2	241	206.6	124.1
2	01.7	01.0	62	53.1	31.9	22	104.6	62.8	82	156.0	93.7	42	207.4	124.6
3	02.6	01.5	63	54.0	32.4	23	105.4	63.3	83	156.9	94.3	43	208.3	125.2
4	03.4	02.1	64	54.9	33.0	24	106.3	63.9	84	157.7	94.8	44	209.1	125.7
5	04.3	02.6	65	55.7	33.5	25	107.1	64.4	85	158.6	95.3	45	210.0	126.2
6	05.1	03.1	66	56.6	34.0	26	108.0	64.9	86	159.4	95.8	46	210.9	126.7
7	06.0	03.6	67	57.4	34.5	27	108.9	65.4	87	160.3	96.3	47	211.7	127.2
8	06.9	04.1	68	58.3	35.0	28	109.7	65.9	88	161.1	96.8	48	212.6	127.7
9	07.7	04.6	69	59.1	35.5	29	110.6	66.4	89	162.0	97.3	49	213.4	128.2
10	08.6	05.2	70	60.0	36.1	30	111.4	67.0	90	162.9	97.9	50	214.3	128.8
11	09.4	05.7	71	60.9	36.6	131	112.3	67.5	191	163.7	98.4	251	215.1	129.3
12	10.3	06.2	72	61.7	37.1	32	113.1	68.0	92	164.6	98.9	52	216.0	129.8
13	11.1	06.7	73	62.6	37.6	33	114.0	68.5	93	165.4	99.4	53	216.9	130.3
14	12.0	07.2	74	63.4	38.1	34	114.9	69.0	94	166.3	99.9	54	217.7	130.8
15	12.9	07.7	75	64.3	38.6	35	115.7	69.5	95	167.1	100.4	55	218.6	131.3
16	13.7	08.2	76	65.1	39.1	36	116.6	70.0	96	168.0	100.9	56	219.4	131.8
17	14.6	08.8	77	66.0	39.7	37	117.4	70.6	97	168.9	101.5	57	220.2	132.4
18	15.4	09.3	78	66.9	40.2	38	118.3	71.1	98	169.7	102.0	58	221.1	132.9
19	16.3	09.8	79	67.7	40.7	39	119.1	71.6	99	170.6	102.5	59	222.0	133.4
20	17.1	10.3	80	68.6	41.2	40	120.0	72.1	200	171.4	103.0	60	222.9	133.9
21	18.0	10.8	81	69.4	41.7	141	120.9	72.6	201	172.3	103.5	261	223.7	134.4
22	18.9	11.3	82	70.3	42.2	42	121.7	73.1	02	173.1	104.0	62	224.6	134.9
23	19.7	11.8	83	71.1	42.7	43	122.6	73.7	03	174.0	104.6	63	225.4	135.5
24	20.6	12.4	84	72.0	43.3	44	123.4	74.2	04	174.9	105.1	64	226.3	136.0
25	21.4	12.9	85	72.9	43.8	45	124.3	74.7	05	175.7	105.6	65	227.1	136.5
26	22.3	13.4	86	73.7	44.3	46	125.1	75.2	06	176.6	106.1	66	228.0	137.0
27	23.1	13.9	87	74.6	44.8	47	126.0	75.7	07	177.4	106.6	67	228.9	137.5
28	24.0	14.4	88	75.4	45.3	48	126.9	76.2	08	178.3	107.1	68	229.7	138.0
29	24.9	14.9	89	76.3	45.8	49	127.7	76.7	09	179.1	107.6	69	230.6	138.5
30	25.7	15.5	90	77.1	46.4	50	128.6	77.3	10	180.0	108.2	70	231.4	139.1
31	26.6	16.0	91	78.0	46.9	151	129.4	77.8	211	180.9	108.7	271	232.2	139.6
32	27.4	16.5	92	78.9	47.4	52	130.3	78.3	12	181.7	109.2	72	233.1	140.1
33	28.3	17.0	93	79.7	47.9	53	131.1	78.8	13	182.6	109.7	73	234.0	140.6
34	29.1	17.5	94	80.6	48.4	54	132.0	79.3	14	183.4	110.2	74	234.9	141.1
35	30.0	18.0	95	81.4	48.9	55	132.9	79.8	15	184.3	110.7	75	235.7	141.6
36	30.9	18.5	96	82.3	49.4	56	133.7	80.3	16	185.1	111.2	76	236.6	142.2
37	31.7	19.1	97	83.1	50.0	57	134.6	80.9	17	186.0	111.8	77	237.4	142.7
38	32.6	19.6	98	84.0	50.5	58	135.4	81.4	18	186.9	112.3	78	238.3	143.2
39	33.4	20.1	99	84.9	51.0	59	136.3	81.9	19	187.7	112.8	79	239.1	143.7
40	34.3	20.6	100	85.7	51.5	60	137.1	82.4	20	188.6	113.3	80	240.0	144.2
41	35.1	21.1	101	86.6	52.0	161	138.0	82.9	221	189.4	113.8	281	240.9	144.7
42	36.0	21.6	02	87.4	52.5	62	138.9	83.4	22	190.3	114.3	82	241.7	145.2
43	36.9	22.1	03	88.3	53.0	63	139.7	84.0	23	191.1	114.9	83	242.6	145.8
44	37.7	22.7	04	89.1	53.6	64	140.6	84.5	24	192.0	115.4	84	243.4	146.3
45	38.6	23.2	05	90.0	54.1	65	141.4	85.0	25	192.9	115.9	85	244.3	146.8
46	39.4	23.7	06	90.9	54.6	66	142.3	85.5	26	193.7	116.4	86	245.1	147.3
47	40.3	24.2	07	91.7	55.1	67	143.1	86.0	27	194.6	116.9	87	246.0	147.8
48	41.1	24.7	08	92.6	55.6	68	144.0	86.5	28	195.4	117.4	88	246.9	148.3
49	42.0	25.2	09	93.4	56.1	69	144.9	87.0	29	196.3	117.9	89	247.7	148.8
50	42.9	25.8	10	94.3	56.7	70	145.7	87.6	30	197.1	118.5	90	248.6	149.4
51	43.7	26.3	111	95.1	57.2	171	146.6	88.1	231	198.0	119.0	291	249.4	149.9
52	44.6	26.8	12	96.0	57.7	72	147.4	88.6	32	198.9	119.5	92	250.3	150.4
53	45.4	27.3	13	96.9	58.2	73	148.3	89.1	33	199.7	120.0	93	251.2	150.9
54	46.3	27.8	14	97.7	58.7	74	149.1	89.6	34	200.6	120.5	94	252.0	151.4
55	47.1	28.3	15	98.6	59.2	75	150.0	90.1	35	201.4	121.0	95	252.9	151.9
56	48.0	28.8	16	99.4	59.7	76	150.9	90.6	36	202.3	121.5	96	253.7	152.5
57	48.9	29.4	17	100.3	60.3	77	151.7	91.2	37	203.1	122.1	97	254.6	153.0
58	49.7	29.9	18	101.1	60.8	78	152.6	91.7	38	204.0	122.6	98	255.4	153.5
59	50.6	30.4	19	102.0	61.3	79	153.4	92.2	39	204.9	123.1	99	256.3	154.0
60	51.4	30.9	20	102.9	61.8	80	154.3	92.7	40	205.7	123.6	300	257.1	154.5
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 59 Degrees.

Difference of Latitude and Departure for 34 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
61	50.6	34.1	121	100.3	67.7	181	150.1	101.2	241	199.8	134.8
62	51.4	34.7	22	101.1	68.2	82	150.9	101.8	42	200.6	135.3
63	52.2	35.2	23	102.0	68.8	83	151.7	102.3	43	201.5	135.9
64	53.1	35.8	24	102.8	69.3	84	152.5	102.9	44	202.3	136.4
65	53.9	36.3	25	103.6	69.9	85	153.4	103.5	45	203.1	137.0
66	54.7	36.9	26	104.5	70.5	86	154.2	104.0	46	203.9	137.6
67	55.5	37.5	27	105.3	71.0	87	155.0	104.6	47	204.8	138.1
68	56.4	38.0	28	106.1	71.6	88	155.9	105.1	48	205.6	138.7
69	57.2	38.6	29	106.9	72.1	89	156.7	105.7	49	206.4	139.2
70	58.0	39.1	30	107.8	72.7	90	157.5	106.2	50	207.3	139.8
71	58.9	39.7	131	108.6	73.3	191	158.3	106.8	251	208.1	140.4
72	59.7	40.3	32	109.4	73.8	92	159.2	107.4	52	208.9	140.9
73	60.5	40.8	33	110.3	74.4	93	160.0	107.9	58	209.7	141.5
74	61.3	41.4	34	111.1	74.9	94	160.8	108.5	54	210.6	142.0
75	62.2	41.9	35	111.9	75.5	95	161.7	109.0	55	211.4	142.6
76	63.0	42.5	36	112.7	76.1	96	162.5	109.6	56	212.2	143.2
77	63.8	43.1	37	113.6	76.6	97	163.3	110.2	57	213.1	143.7
78	64.7	43.6	38	114.4	77.2	98	164.1	110.7	58	213.9	144.3
79	65.5	44.2	39	115.2	77.7	99	165.0	111.3	59	214.7	144.8
80	66.3	44.7	40	116.1	78.3	200	165.8	111.8	60	215.5	145.4
81	67.1	45.3	141	116.9	78.8	201	166.6	112.4	261	216.4	145.9
82	68.0	45.9	42	117.7	79.4	02	167.5	113.0	62	217.2	146.5
83	68.8	46.4	43	118.6	80.0	03	168.3	113.5	63	218.0	147.1
84	69.6	47.0	44	119.4	80.5	04	169.1	114.1	64	218.9	147.6
85	70.5	47.5	45	120.2	81.1	05	170.0	114.6	65	219.7	148.2
86	71.3	48.1	46	121.0	81.6	06	170.8	115.2	66	220.5	148.7
87	72.1	48.6	47	121.9	82.2	07	171.6	115.8	67	221.4	149.3
88	73.0	49.2	48	122.7	82.8	08	172.4	116.3	68	222.2	149.9
89	73.8	49.8	49	123.5	83.3	09	173.3	116.9	69	223.0	150.4
90	74.6	50.3	50	124.4	83.9	10	174.1	117.4	70	223.8	151.0
91	75.4	50.9	151	125.2	84.4	211	174.9	118.0	271	224.7	151.5
92	76.3	51.4	52	126.0	85.0	12	175.8	118.5	72	225.5	152.1

TABLE II. Difference of Latitude and Departure for 33 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.5	61	51.2	33.2	121	101.5	65.9	181	151.8	98.6	241	202.1	131.3
2	01.7	01.1	62	52.0	33.8	22	102.3	66.4	82	152.6	99.1	42	203.0	131.8
3	02.5	01.6	63	52.8	34.3	23	103.2	67.0	83	153.5	99.7	43	203.8	132.3
4	03.4	02.2	64	53.7	34.9	24	104.0	67.5	84	154.3	100.2	44	204.6	132.9
5	04.2	02.7	65	54.5	35.4	25	104.8	68.1	85	155.2	100.8	45	205.5	133.4
6	05.0	03.3	66	55.4	35.9	26	105.7	68.6	86	156.0	101.3	46	206.3	134.0
7	05.9	03.8	67	56.2	36.5	27	106.5	69.2	87	156.8	101.8	47	207.2	134.5
8	06.7	04.4	68	57.0	37.0	28	107.3	69.7	88	157.7	102.4	48	208.0	135.1
9	07.5	04.9	69	57.9	37.6	29	108.2	70.3	89	158.5	102.9	49	208.8	135.6
10	08.4	05.4	70	58.7	38.1	30	109.0	70.8	90	159.3	103.5	50	209.7	136.2
11	09.2	06.0	71	59.5	38.7	131	109.9	71.3	191	160.2	104.0	251	210.5	136.7
12	10.1	06.5	72	60.4	39.2	32	110.7	71.9	92	161.0	104.6	52	211.3	137.2
13	10.9	07.1	73	61.2	39.8	33	111.5	72.4	93	161.9	105.1	53	212.2	137.8
14	11.7	07.6	74	62.1	40.3	34	112.4	73.0	94	162.7	105.7	54	213.0	138.3
15	12.6	08.2	75	62.9	40.8	35	113.2	73.5	95	163.5	106.2	55	213.9	138.9
16	13.4	08.7	76	63.7	41.4	36	114.1	74.1	96	164.4	106.7	56	214.7	139.4
17	14.3	09.3	77	64.6	41.9	37	114.9	74.6	97	165.2	107.3	57	215.5	140.0
18	15.1	09.8	78	65.4	42.5	38	115.7	75.2	98	166.0	107.8	58	216.4	140.5
19	15.9	10.3	79	66.3	43.0	39	116.6	75.7	99	166.9	108.4	59	217.2	141.1
20	16.8	10.9	80	67.1	43.6	40	117.4	76.2	200	167.7	108.9	60	218.1	141.6
21	17.6	11.4	81	67.9	44.1	141	118.3	76.8	201	168.6	109.5	261	218.9	142.2
22	18.5	12.0	82	68.8	44.7	42	119.1	77.3	02	169.4	110.0	62	219.7	142.7
23	19.3	12.5	83	69.6	45.2	43	119.9	77.9	03	170.3	110.6	63	220.6	143.2
24	20.1	13.1	84	70.4	45.7	44	120.8	78.4	04	171.1	111.1	64	221.4	143.8
25	21.0	13.6	85	71.3	46.3	45	121.6	79.0	05	171.9	111.7	65	222.2	144.3
26	21.8	14.2	86	72.1	46.8	46	122.4	79.5	06	172.8	112.2	66	223.1	144.9
27	22.6	14.7	87	73.0	47.4	47	123.3	80.1	07	173.6	112.7	67	223.9	145.4
28	23.5	15.2	88	73.8	47.9	48	124.1	80.6	08	174.4	113.3	68	224.8	146.0
29	24.3	15.8	89	74.6	48.5	49	125.0	81.2	09	175.3	113.8	69	225.6	146.5
30	25.2	16.3	90	75.5	49.0	50	125.8	81.7	10	176.1	114.4	70	226.4	147.1
31	26.0	16.9	91	76.3	49.6	151	126.6	82.2	211	177.0	114.9	271	227.3	147.6
32	26.8	17.4	92	77.2	50.1	52	127.5	82.8	12	177.8	115.5	72	228.1	148.1
33	27.7	18.0	93	78.0	50.7	53	128.3	83.3	13	178.6	116.0	73	229.0	148.7
34	28.5	18.5	94	78.8	51.2	54	129.2	83.9	14	179.5	116.6	74	229.8	149.2
35	29.4	19.1	95	79.7	51.7	55	130.0	84.4	15	180.3	117.1	75	230.6	149.8
36	30.2	19.6	96	80.5	52.3	56	130.8	85.0	16	181.2	117.6	76	231.5	150.3
37	31.0	20.2	97	81.4	52.8	57	131.7	85.5	17	182.0	118.2	77	232.3	150.9
38	31.9	20.7	98	82.2	53.4	58	132.5	86.1	18	182.8	118.7	78	233.2	151.4
39	32.7	21.2	99	83.0	53.9	59	133.3	86.6	19	183.7	119.3	79	234.0	152.0
40	33.5	21.8	100	83.9	54.5	60	134.2	87.1	20	184.5	119.8	80	234.8	152.4
41	34.4	22.3	101	84.7	55.0	161	135.0	87.7	221	185.3	120.4	281	235.7	153.0
42	35.2	22.9	02	85.5	55.6	62	135.9	88.2	22	186.2	120.9	82	236.5	153.6
43	36.1	23.4	03	86.4	56.1	63	136.7	88.8	23	187.0	121.5	83	237.3	154.1
44	36.9	24.0	04	87.2	56.6	64	137.5	89.3	24	187.9	122.0	84	238.2	154.7
45	37.7	24.5	05	88.1	57.2	65	138.4	89.9	25	188.7	122.5	85	239.0	155.2
46	38.6	25.1	06	88.9	57.7	66	139.2	90.4	26	189.5	123.1	86	239.9	155.8
47	39.4	25.6	07	89.7	58.3	67	140.1	91.0	27	190.4	123.6	87	240.7	156.3
48	40.3	26.1	08	90.6	58.8	68	140.9	91.5	28	191.2	124.2	88	241.5	156.9
49	41.1	26.7	09	91.4	59.4	69	141.7	92.0	29	192.1	124.7	89	242.4	157.4
50	41.9	27.2	10	92.3	59.9	70	142.6	92.6	30	192.9	125.3	90	243.2	157.9
51	42.8	27.8	111	93.1	60.5	171	143.4	93.1	231	193.7	125.8	291	244.1	158.5
52	43.6	28.3	12	93.9	61.0	72	144.3	93.7	32	194.6	126.4	92	244.9	159.0
53	44.4	28.9	13	94.8	61.5	73	145.1	94.2	33	195.4	126.9	93	245.7	159.6
54	45.3	29.4	14	95.6	62.1	74	145.9	94.8	34	196.2	127.4	94	246.6	160.1
55	46.1	30.0	15	96.4	62.6	75	146.8	95.3	35	197.1	128.0	95	247.4	160.7
56	47.0	30.5	16	97.3	63.2	76	147.6	95.9	36	197.9	128.5	96	248.2	161.2
57	47.8	31.0	17	98.1	63.7	77	148.4	96.4	37	198.8	129.1	97	249.1	161.8
58	48.6	31.6	18	99.0	64.3	78	149.3	96.9	38	199.6	129.6	98	249.9	162.3
59	49.5	32.1	19	99.8	64.8	79	150.1	97.5	39	200.4	130.2	99	250.8	162.8
60	50.3	32.7	20	100.6	65.4	80	151.0	98.0	40	201.3	130.7	300	251.6	163.4
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 57 Degrees.

Difference of Latitude and Departure for 36 Degrees.

ist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
61	49.4	35.9	121	97.9	71.1	181	146.4	106.4	241	195.0	141.7
62	50.2	36.4	22	98.7	71.7	82	147.2	107.0	42	195.8	142.2
63	51.0	37.0	23	99.5	72.3	83	148.1	107.6	43	196.6	142.8
64	51.8	37.6	24	100.3	72.9	84	148.9	108.2	44	197.4	143.4
65	52.6	38.2	25	101.1	73.5	85	149.7	108.7	45	198.2	144.0
66	53.4	38.8	26	101.9	74.1	86	150.5	109.3	46	199.0	144.6
67	54.2	39.4	27	102.7	74.6	87	151.3	109.9	47	199.8	145.2
68	55.0	40.0	28	103.6	75.2	88	152.1	110.5	48	200.6	145.8
69	55.8	40.6	29	104.4	75.8	89	152.9	111.1	49	201.4	146.4
70	56.6	41.1	30	105.2	76.4	90	153.7	111.7	50	202.3	146.9
71	57.4	41.7	131	106.0	77.0	191	154.5	112.3	251	203.1	147.5
72	58.2	42.3	32	106.8	77.6	92	155.3	112.9	52	203.9	148.1
73	59.1	42.9	33	107.6	78.2	93	156.1	113.4	53	204.7	148.7
74	59.9	43.5	34	108.4	78.8	94	156.9	114.0	54	205.5	149.3
75	60.7	44.1	35	109.2	79.4	95	157.8	114.6	55	206.3	149.9
76	61.5	44.7	36	110.0	79.9	96	158.6	115.2	56	207.1	150.5
77	62.3	45.3	37	110.8	80.5	97	159.4	115.8	57	207.9	151.1
78	63.1	45.8	38	111.6	81.1	98	160.2	116.4	58	208.7	151.6
79	63.9	46.4	39	112.5	81.7	99	161.0	117.0	59	209.5	152.2
80	64.7	47.0	40	113.3	82.3	200	161.8	117.6	60	210.3	152.8
81	65.5	47.6	141	114.1	82.9	201	162.6	118.1	261	211.2	153.4
82	66.3	48.2	42	114.9	83.5	02	163.4	118.7	62	212.0	154.0
83	67.1	48.8	43	115.7	84.1	03	164.2	119.3	63	212.8	154.6
84	68.0	49.4	44	116.5	84.6	04	165.0	119.9	64	213.6	155.2
85	68.8	50.0	45	117.3	85.2	05	165.8	120.5	65	214.4	155.8
86	69.6	50.5	46	118.1	85.8	06	166.7	121.1	66	215.2	156.4
87	70.4	51.1	47	118.9	86.4	07	167.5	121.7	67	216.0	156.9
88	71.2	51.7	48	119.7	87.0	08	168.3	122.3	68	216.8	157.5
89	72.0	52.3	49	120.5	87.6	09	169.1	122.8	69	217.6	158.1
90	72.8	52.9	50	121.4	88.2	10	169.9	123.4	70	218.4	158.7
91	73.6	58.5	151	122.2	88.8	211	170.7	124.0	271	219.2	159.3
92	74.4	54.1	52	123.0	89.3	12	171.5	124.6	72	220.1	159.9

TABLE II. Difference of Latitude and Departure for 35 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	50.0	35.0	121	99.1	69.4	181	148.3	103.8	241	197.4	138.2
2	01.6	01.1	62	50.8	35.6	22	99.9	70.0	82	149.1	104.4	42	198.2	138.8
3	02.5	01.7	63	51.6	36.1	23	100.8	70.5	83	149.9	105.0	43	199.1	139.4
4	03.3	02.3	64	52.4	36.7	24	101.6	71.1	84	150.7	105.5	44	199.9	140.0
5	04.1	02.9	65	53.2	37.3	25	102.4	71.7	85	151.5	106.1	45	200.7	140.5
6	04.9	03.4	66	54.1	37.9	26	103.2	72.3	86	152.4	106.7	46	201.5	141.1
7	05.7	04.0	67	54.9	38.4	27	104.0	72.8	87	153.2	107.3	47	202.3	141.7
8	06.6	04.6	68	55.7	39.0	28	104.9	73.4	88	154.0	107.8	48	203.1	142.2
9	07.4	05.2	69	56.5	39.6	29	105.7	74.0	89	154.8	108.4	49	204.0	142.8
10	08.2	05.7	70	57.3	40.2	30	106.5	74.6	90	155.6	109.0	50	204.8	143.4
11	09.0	06.3	71	58.2	40.7	131	107.3	75.1	191	156.5	109.5	251	205.6	144.0
12	09.8	06.9	72	59.0	41.3	32	108.1	75.7	92	157.3	110.1	52	206.4	144.5
13	10.6	07.5	73	59.8	41.9	33	108.9	76.3	93	158.1	110.7	53	207.2	145.1
14	11.5	08.0	74	60.6	42.4	34	109.8	76.9	94	158.9	111.3	54	208.1	145.7
15	12.3	08.6	75	61.4	43.0	35	110.6	77.4	95	159.7	111.8	55	208.9	146.3
16	13.1	09.2	76	62.2	43.6	36	111.4	78.0	96	160.6	112.4	56	209.7	146.8
17	13.9	09.8	77	63.1	44.2	37	112.2	78.6	97	161.4	113.0	57	210.5	147.4
18	14.7	10.3	78	63.9	44.7	38	113.0	79.2	98	162.2	113.6	58	211.3	148.0
19	15.6	10.9	79	64.7	45.3	39	113.8	79.7	99	163.0	114.1	59	212.2	148.5
20	16.4	11.5	80	65.5	45.9	40	114.7	80.3	200	163.8	114.7	60	213.0	149.1
21	17.2	12.0	81	66.4	46.5	141	115.5	80.9	201	164.6	115.3	261	213.8	149.7
22	18.0	12.6	82	67.2	47.0	42	116.3	81.4	02	165.5	115.9	62	214.6	150.3
23	18.8	13.2	83	68.0	47.6	43	117.1	82.0	03	166.3	116.4	63	215.4	150.9
24	19.7	13.8	84	68.8	48.2	44	118.0	82.6	04	167.1	117.0	64	216.3	151.4
25	20.5	14.3	85	69.6	48.8	45	118.8	83.2	05	167.9	117.6	65	217.1	152.0
26	21.3	14.9	86	70.4	49.3	46	119.6	83.7	06	168.7	118.2	66	217.9	152.6
27	22.1	15.5	87	71.3	49.9	47	120.4	84.3	07	169.6	118.7	67	218.7	153.1
28	22.9	16.1	88	72.1	50.5	48	121.2	84.9	08	170.4	119.3	68	219.5	153.7
29	23.8	16.6	89	72.9	51.0	49	122.1	85.5	09	171.2	119.9	69	220.4	154.3
30	24.6	17.2	90	73.7	51.6	50	122.9	86.0	10	172.0	120.5	70	221.2	154.9
31	25.4	17.8	91	74.5	52.2	151	123.7	86.6	211	172.8	121.0	271	221.0	155.4
32	26.2	18.4	92	75.4	52.8	52	124.5	87.2	12	173.7	121.6	72	222.8	156.0
33	27.0	18.9	93	76.2	53.3	53	125.3	87.8	13	174.5	122.2	73	223.6	156.6
34	27.9	19.5	94	77.0	53.9	54	126.1	88.3	14	175.3	122.7	74	224.4	157.2
35	28.7	20.1	95	77.8	54.5	55	127.0	88.9	15	176.1	123.3	75	225.3	157.7
36	29.5	20.6	96	78.6	55.1	56	127.8	89.5	16	176.9	123.9	76	226.1	158.3
37	30.3	21.2	97	79.5	55.6	57	128.6	90.1	17	177.8	124.5	77	226.9	158.9
38	31.1	21.8	98	80.3	56.2	58	129.4	90.6	18	178.6	125.0	78	227.7	159.5
39	31.9	22.4	99	81.1	56.8	59	130.2	91.2	19	179.4	125.6	79	228.5	160.0
40	32.8	22.9	100	81.9	57.4	60	131.1	91.8	20	180.2	126.2	80	229.4	160.6
41	33.6	23.5	101	82.7	57.9	161	131.9	92.3	221	181.0	126.8	281	230.2	161.2
42	34.4	24.1	02	83.6	58.5	62	132.7	92.9	22	181.9	127.3	82	231.0	161.7
43	35.2	24.7	03	84.4	59.1	63	133.5	93.5	23	182.7	127.9	83	231.8	162.3
44	36.0	25.2	04	85.2	59.7	64	134.3	94.1	24	183.5	128.5	84	232.6	162.9
45	36.9	25.8	05	86.0	60.2	65	135.2	94.6	25	184.3	129.1	85	233.5	163.5
46	37.7	26.4	06	86.8	60.8	66	136.0	95.2	26	185.1	129.6	86	234.3	164.0
47	38.5	27.0	07	87.6	61.4	67	136.8	95.8	27	185.9	130.2	87	235.1	164.6
48	39.3	27.5	08	88.5	61.9	68	137.6	96.4	28	186.8	130.8	88	235.9	165.2
49	40.1	28.1	09	89.3	62.5	69	138.4	96.9	29	187.6	131.3	89	236.7	165.8
50	41.0	28.7	10	90.1	63.1	70	139.3	97.5	30	188.4	131.9	90	237.6	166.3
51	41.8	29.2	111	90.9	63.7	171	140.1	98.1	231	189.2	132.5	291	238.4	166.9
52	42.6	29.8	12	91.7	64.2	72	140.9	98.7	32	190.0	133.1	92	239.2	167.5
53	43.4	30.4	13	92.6	64.8	73	141.7	99.2	33	190.9	133.6	93	240.0	168.1
54	44.2	31.0	14	93.4	65.4	74	142.5	99.8	34	191.7	134.2	94	240.8	168.6
55	45.1	31.5	15	94.2	66.0	75	143.4	100.4	35	192.5	134.8	95	241.6	169.2
56	45.9	32.1	16	95.0	66.5	76	144.2	100.9	36	193.3	135.4	96	242.5	169.8
57	46.7	32.7	17	95.8	67.1	77	145.0	101.5	37	194.1	135.9	97	243.3	170.4
58	47.5	33.3	18	96.7	67.7	78	145.8	102.1	38	195.0	136.5	98	244.1	170.9
59	48.3	33.8	19	97.5	68.3	79	146.6	102.7	39	195.8	137.1	99	244.9	171.5
60	49.1	34.4	20	98.3	68.8	80	147.4	103.2	40	196.6	137.7	300	245.7	172.1
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 55 Degrees.

TABLE II. Difference of Latitude and Departure for 38 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	48.1	37.6	121	95.3	74.5	181	142.6	111.4	241	189.9	148.4
2	01.6	01.2	62	48.9	38.2	22	96.1	75.1	82	143.4	112.1	42	190.7	149.0
3	02.4	01.8	63	49.6	38.8	23	96.9	75.7	83	144.2	112.7	43	191.5	149.6
4	03.2	02.5	64	50.4	39.4	24	97.7	76.3	84	145.0	113.3	44	192.3	150.2
5	03.9	03.1	65	51.2	40.0	25	98.5	77.0	85	145.8	113.9	45	193.1	150.8
6	04.7	03.7	66	52.0	40.6	26	99.3	77.6	86	146.6	114.5	46	193.9	151.5
7	05.5	04.3	67	52.8	41.2	27	100.1	78.2	87	147.4	115.1	47	194.6	152.1
8	06.3	04.9	68	53.6	41.9	28	100.9	78.8	88	148.1	115.7	48	195.4	152.7
9	07.1	05.6	69	54.4	42.5	29	101.7	79.4	89	148.9	116.4	49	196.2	153.3
10	07.9	06.2	70	55.2	43.1	30	102.4	80.0	90	149.7	117.0	50	197.0	153.9
11	08.7	06.8	71	55.9	43.7	131	103.2	80.7	191	150.5	117.6	251	197.8	154.5
12	09.5	07.4	72	56.7	44.3	32	104.0	81.3	92	151.3	118.2	52	198.6	155.1
13	10.2	08.0	73	57.5	44.9	33	104.8	81.9	93	152.1	118.8	53	199.4	155.8
14	11.0	08.6	74	58.3	45.6	34	105.6	82.5	94	152.9	119.4	54	200.2	156.4
15	11.8	09.2	75	59.1	46.2	35	106.4	83.1	95	153.7	120.1	55	200.9	157.0
16	12.6	09.9	76	59.9	46.8	36	107.2	83.7	96	154.5	120.7	56	201.7	157.6
17	13.4	10.5	77	60.7	47.4	37	108.0	84.3	97	155.2	121.3	57	202.5	158.2
18	14.2	11.1	78	61.5	48.0	38	108.7	85.0	98	156.0	121.9	58	203.3	158.8
19	15.0	11.7	79	62.3	48.6	39	109.5	85.6	99	156.8	122.5	59	204.1	159.5
20	15.8	12.3	80	63.0	49.3	40	110.3	86.2	200	157.6	123.1	60	204.9	160.1
21	16.5	12.9	81	63.8	49.9	141	111.1	86.8	201	158.4	123.7	261	205.7	160.7
22	17.3	13.5	82	64.6	50.5	42	111.9	87.4	02	159.2	124.4	62	206.5	161.3
23	18.1	14.2	83	65.4	51.1	42	112.7	88.0	03	160.0	125.0	63	207.2	161.9
24	18.9	14.8	84	66.2	51.7	44	113.5	88.7	04	160.8	125.6	64	208.0	162.5
25	19.7	15.4	85	67.0	52.3	45	114.3	89.3	05	161.5	126.2	65	208.8	163.2
26	20.5	16.0	86	67.8	52.9	46	115.0	89.9	06	162.3	126.8	66	209.6	163.8
27	21.3	16.6	87	68.6	53.6	47	115.8	90.5	07	163.1	127.4	67	210.4	164.4
28	22.1	17.2	88	69.3	54.2	48	116.6	91.1	08	163.9	128.1	68	211.2	165.0
29	22.9	17.9	89	70.1	54.8	49	117.4	91.7	09	164.7	128.7	69	212.0	165.6
30	23.6	18.5	90	70.9	55.4	50	118.2	92.3	10	165.5	129.3	70	212.8	166.2
31	24.4	19.1	91	71.7	56.0	151	119.0	93.0	211	166.3	129.9	271	213.6	166.8
32	25.2	19.7	92	72.5	56.6	52	119.8	93.6	12	167.1	130.5	72	214.3	167.5
33	26.0	20.3	93	73.3	57.3	53	120.6	94.2	13	167.8	131.1	73	215.1	168.1
34	26.8	20.9	94	74.1	57.9	54	121.4	94.8	14	168.6	131.8	74	215.9	168.7
35	27.6	21.5	95	74.9	58.5	55	122.1	95.4	15	169.4	132.4	75	216.7	169.3
36	28.4	22.2	96	75.6	59.1	56	122.9	96.0	16	170.2	133.0	76	217.5	169.9
37	29.2	22.8	97	76.4	59.7	57	123.7	96.7	17	171.0	133.6	77	218.3	170.5
38	29.9	23.4	98	77.2	60.3	58	124.5	97.3	18	171.8	134.2	78	219.1	171.2
39	30.7	24.0	99	78.0	61.0	59	125.3	97.9	19	172.6	134.8	79	219.9	171.8
40	31.5	24.6	100	78.8	61.6	60	126.1	98.5	20	173.4	135.5	80	220.6	172.4
41	32.3	25.2	101	79.6	62.2	161	126.9	99.1	221	174.2	136.1	281	221.4	173.0
42	33.1	25.9	02	80.4	62.8	62	127.7	99.7	22	174.9	136.7	82	222.2	173.6
43	33.9	26.5	03	81.2	63.4	63	128.4	100.4	23	175.7	137.3	83	223.0	174.2
44	34.7	27.1	04	82.0	64.0	64	129.2	101.0	24	176.5	137.9	84	223.8	174.8
45	35.5	27.7	05	82.7	64.6	65	130.0	101.6	25	177.3	138.5	85	224.6	175.5
46	36.2	28.3	06	83.5	65.3	66	130.8	102.2	26	178.1	139.1	86	225.4	176.1
47	37.0	28.9	07	84.3	65.9	67	131.6	102.8	27	178.9	139.8	87	226.2	176.7
48	37.8	29.6	08	85.1	66.5	68	132.4	103.4	28	179.7	140.4	88	226.9	177.3
49	38.6	30.2	09	85.9	67.1	69	133.2	104.0	29	180.5	141.0	89	227.7	177.9
50	39.4	30.8	10	86.7	67.7	70	134.0	104.7	30	181.2	141.6	90	228.5	178.5
51	40.2	31.4	111	87.5	68.3	171	134.7	105.3	231	182.0	142.2	291	229.3	179.2
52	41.0	32.0	12	88.3	69.0	72	135.5	105.9	32	182.8	142.8	92	230.1	179.8
53	41.8	32.6	13	89.0	69.6	73	136.3	106.5	33	183.6	143.4	93	230.9	180.4
54	42.6	33.2	14	89.8	70.2	74	137.1	107.1	34	184.4	144.1	94	231.7	181.0
55	43.3	33.9	15	90.6	70.8	75	137.9	107.7	35	185.2	144.7	95	232.5	181.6
56	44.1	34.5	16	91.4	71.4	76	138.7	108.4	36	186.0	145.3	96	233.3	182.2
57	44.9	35.1	17	92.2	72.0	77	139.5	109.0	37	186.8	145.9	97	234.0	182.9
58	45.7	35.7	18	93.0	72.6	78	140.3	109.6	38	187.5	146.5	98	234.8	183.5
59	46.5	36.3	19	93.8	73.3	79	141.1	110.2	39	188.3	147.1	99	235.6	184.1
60	47.3	36.9	20	94.6	73.9	80	141.8	110.8	40	129.1	147.8	300	236.4	184.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 52 Degrees.

TABLE II. Difference of Latitude and Departure for 37 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	48.7	36.7	121	96.6	72.8	181	144.6	108.9	241	192.5	145.0
2	01.6	01.2	62	49.5	37.3	22	97.4	73.4	82	145.4	109.5	42	193.3	145.6
3	02.4	01.8	63	50.3	37.9	23	98.2	74.0	83	146.2	110.1	43	194.1	146.2
4	03.2	02.4	64	51.1	38.5	24	99.0	74.6	84	146.9	110.7	44	194.9	146.8
5	04.0	03.0	65	51.9	39.1	25	99.8	75.2	85	147.7	111.3	45	195.7	147.4
6	04.8	03.6	66	52.7	39.7	26	100.6	75.8	86	148.5	111.9	46	196.5	148.0
7	05.6	04.2	67	53.5	40.3	27	101.4	76.4	87	149.3	112.5	47	197.3	148.6
8	06.4	04.8	68	54.3	40.9	28	102.2	77.0	88	150.1	113.1	48	198.1	149.3
9	07.2	05.4	69	55.1	41.5	29	103.0	77.6	89	150.9	113.7	49	198.9	149.9
10	08.0	06.0	70	55.9	42.1	30	103.8	78.2	90	151.7	114.3	50	199.7	150.5
11	08.8	06.6	71	56.7	42.7	131	104.6	78.8	191	152.5	114.9	251	200.5	151.1
12	09.6	07.2	72	57.5	43.3	32	105.4	79.4	92	153.3	115.5	52	201.3	151.7
13	10.4	07.8	73	58.3	43.9	33	106.2	80.0	93	154.1	116.2	53	202.1	152.3
14	11.2	08.4	74	59.1	44.5	34	107.0	80.6	94	154.9	116.8	54	202.9	152.9
15	12.0	09.0	75	59.9	45.1	35	107.8	81.2	95	155.7	117.4	55	203.7	153.5
16	12.8	09.6	76	60.7	45.7	36	108.6	81.8	96	156.5	118.0	56	204.5	154.1
17	13.6	10.2	77	61.5	46.3	37	109.4	82.4	97	157.3	118.6	57	205.2	154.7
18	14.4	10.8	78	62.3	46.9	38	110.2	83.1	98	158.1	119.2	58	206.0	155.3
19	15.2	11.4	79	63.1	47.5	39	111.0	83.7	99	158.9	119.8	59	206.8	155.9
20	16.0	12.0	80	63.9	48.1	40	111.8	84.3	200	159.7	120.4	60	207.6	156.5
21	16.8	12.6	81	64.7	48.7	141	112.6	84.9	201	160.5	121.0	261	208.4	157.1
22	17.6	13.2	82	65.5	49.3	42	113.4	85.5	02	161.3	121.6	62	209.2	157.7
23	18.4	13.8	83	66.3	50.0	43	114.2	86.1	03	162.1	122.2	63	210.0	158.3
24	19.2	14.4	84	67.1	50.6	44	115.0	86.7	04	162.9	122.8	64	210.8	158.9
25	20.0	15.0	85	67.9	51.2	45	115.8	87.3	05	163.7	123.4	65	211.6	159.5
26	20.8	15.6	86	68.7	51.8	46	116.6	87.9	06	164.5	124.0	66	212.4	160.1
27	21.6	16.2	87	69.5	52.4	47	117.4	88.5	07	165.3	124.6	67	213.2	160.7
28	22.4	16.9	88	70.3	53.0	48	118.2	89.1	08	166.1	125.2	68	214.0	161.3
29	23.2	17.5	89	71.1	53.6	49	119.0	89.7	09	166.9	125.8	69	214.8	161.9
30	24.0	18.1	90	71.9	54.2	50	119.8	90.3	10	167.7	126.4	70	215.6	162.5
31	24.8	18.7	91	72.7	54.8	151	120.6	90.9	211	168.5	127.0	271	216.4	163.1
32	25.6	19.3	92	73.5	55.4	52	121.4	91.5	12	169.3	127.6	72	217.2	163.7
33	26.4	19.9	93	74.3	56.0	53	122.2	92.1	13	170.1	128.2	73	218.0	164.3
34	27.2	20.5	94	75.1	56.6	54	123.0	92.7	14	170.9	128.8	74	218.8	164.9
35	28.0	21.1	95	75.9	57.2	55	123.8	93.3	15	171.7	129.4	75	219.6	165.5
36	28.8	21.7	96	76.7	57.8	56	124.6	93.9	16	172.5	130.0	76	220.4	166.1
37	29.5	22.3	97	77.5	58.4	57	125.4	94.5	17	173.3	130.6	77	221.2	166.7
38	30.3	22.9	98	78.3	59.0	58	126.2	95.1	18	174.1	131.2	78	222.0	167.3
39	31.1	23.5	99	79.1	59.6	59	127.0	95.7	19	174.9	131.8	79	222.8	167.9
40	31.9	24.1	100	79.9	60.2	60	127.8	96.3	20	175.7	132.4	80	223.6	168.5
41	32.7	24.7	101	80.7	60.8	161	128.6	96.9	221	176.5	133.0	281	224.4	169.1
42	33.5	25.3	02	81.5	61.4	62	129.4	97.5	22	177.3	133.6	82	225.2	169.7
43	34.3	25.9	03	82.3	62.0	63	130.2	98.1	23	178.1	134.2	83	226.0	170.3
44	35.1	26.5	04	83.1	62.6	64	131.0	98.7	24	178.9	134.8	84	226.8	170.9
45	35.9	27.1	05	83.9	63.2	65	131.8	99.3	25	179.7	135.4	85	227.6	171.5
46	36.7	27.7	06	84.7	63.8	66	132.6	99.9	26	180.5	136.0	86	228.4	172.1
47	37.5	28.3	07	85.5	64.4	67	133.4	100.5	27	181.3	136.6	87	229.2	172.7
48	38.3	28.9	08	86.3	65.0	68	134.2	101.1	28	182.1	137.2	88	230.0	173.3
49	39.1	29.5	09	87.1	65.6	69	135.0	101.7	29	182.9	137.8	89	230.8	173.9
50	39.9	30.1	10	87.8	66.2	70	135.8	102.3	30	183.7	138.4	90	231.6	174.5
51	40.7	30.7	111	88.6	66.8	171	136.6	102.9	231	184.5	139.0	291	232.4	175.1
52	41.5	31.3	12	89.4	67.4	72	137.4	103.5	32	185.3	139.6	92	233.2	175.7
53	42.3	31.9	13	90.2	68.0	73	138.2	104.1	33	186.1	140.2	93	234.0	176.3
54	43.1	32.5	14	91.0	68.6	74	139.0	104.7	34	186.9	140.8	94	234.8	176.9
55	43.9	33.1	15	91.8	69.2	75	139.8	105.3	35	187.7	141.4	95	235.6	177.5
56	44.7	33.7	16	92.6	69.8	76	140.6	105.9	36	188.5	142.0	96	236.4	178.1
57	45.5	34.3	17	93.4	70.4	77	141.4	106.5	37	189.3	142.6	97	237.2	178.7
58	46.3	34.9	18	94.2	71.0	78	142.2	107.1	38	190.1	143.2	98	238.0	179.3
59	47.1	35.5	19	95.0	71.6	79	143.0	107.7	39	190.9	143.8	99	238.8	179.9
60	47.9	36.1	20	95.8	72.2	80	143.8	108.3	40	191.7	144.4	300	239.6	180.5
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 53 Degrees.

TABLE II. Difference of Latitude and Departure for 40 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	46.7	39.2	121	92.7	77.8	181	138.7	116.3	241	184.6	154.9
2	01.5	01.3	62	47.5	39.9	22	93.5	78.4	82	139.4	117.0	42	185.4	155.6
3	02.3	01.9	63	48.3	40.5	23	94.2	79.1	83	140.2	117.6	43	186.1	156.2
4	03.1	02.6	64	49.0	41.1	24	95.0	79.7	84	141.0	118.3	44	186.9	156.8
5	03.8	03.2	65	49.8	41.8	25	95.7	80.3	85	141.7	118.9	45	187.7	157.5
6	04.6	03.9	66	50.6	42.4	26	96.5	81.0	86	142.5	119.6	46	188.4	158.1
7	05.4	04.5	67	51.3	43.1	27	97.3	81.6	87	143.2	120.2	47	189.2	158.8
8	06.1	05.1	68	52.1	43.7	28	98.1	82.3	88	144.0	120.8	48	190.0	159.4
9	06.9	05.8	69	52.9	44.4	29	98.8	82.9	89	144.8	121.5	49	190.7	160.1
10	07.7	06.4	70	53.6	45.0	30	99.6	83.6	90	145.5	122.1	50	191.5	160.7
11	08.4	07.1	71	54.4	45.6	131	100.4	84.2	191	146.3	122.8	251	192.3	161.3
12	09.2	07.7	72	55.2	46.3	32	101.1	84.8	92	147.1	123.4	52	193.0	162.0
13	10.0	08.4	73	55.9	46.9	33	101.9	85.5	93	147.8	124.1	53	193.8	162.6
14	10.7	09.0	74	56.7	47.6	34	102.6	86.1	94	148.6	124.7	54	194.6	163.3
15	11.5	09.6	75	57.5	48.2	35	103.4	86.8	95	149.4	125.3	55	195.3	163.9
16	12.3	10.3	76	58.2	48.9	36	104.2	87.4	96	150.1	126.0	56	196.1	164.6
17	13.0	10.9	77	59.0	49.5	37	104.9	88.1	97	150.9	126.6	57	196.9	165.2
18	13.8	11.6	78	59.8	50.1	38	105.7	88.7	98	151.7	127.3	58	197.6	165.9
19	14.6	12.2	79	60.5	50.8	39	106.5	89.3	99	152.4	127.9	59	198.4	166.5
20	15.2	12.9	80	61.3	51.4	40	107.2	90.0	200	153.2	128.6	60	199.2	167.1
21	16.1	13.5	81	62.0	52.1	141	108.0	90.6	201	154.0	129.2	261	199.9	167.8
22	16.9	14.1	82	62.8	52.7	42	108.8	91.3	02	154.7	129.8	62	200.7	168.4
23	17.6	14.8	83	63.6	53.4	43	109.5	91.9	03	155.5	130.5	63	201.5	169.1
24	18.4	15.4	84	64.3	54.0	44	110.3	92.6	04	156.3	131.1	64	202.2	169.7
25	19.2	16.1	85	65.1	54.6	45	111.1	93.2	05	157.0	131.8	65	203.0	170.3
26	19.9	16.7	86	65.9	55.3	46	111.8	93.8	06	157.8	132.4	66	203.8	171.0
27	20.7	17.4	87	66.6	55.9	47	112.6	94.5	07	158.6	133.1	67	204.5	171.6
28	21.4	18.0	88	67.4	56.6	48	113.4	95.1	08	159.3	133.7	68	205.3	172.3
29	22.2	18.6	89	68.2	57.2	49	114.1	95.8	09	160.1	134.3	69	206.1	172.9
30	23.0	19.3	90	68.9	57.9	50	114.9	96.4	10	160.9	135.0	70	206.8	173.6
31	23.7	19.9	91	69.7	58.5	151	115.7	97.1	211	161.6	135.6	271	207.6	174.2
32	24.5	20.6	92	70.5	59.1	52	116.4	97.7	12	162.4	136.3	72	208.4	174.8
33	25.3	21.2	93	71.2	59.8	53	117.2	98.3	13	163.2	136.9	73	209.1	175.5
34	26.0	21.9	94	72.0	60.4	54	118.0	99.0	14	163.9	137.6	74	209.9	176.1
35	26.8	22.5	95	72.8	61.1	55	118.7	99.6	15	164.7	138.2	75	210.6	176.8
36	27.6	23.1	96	73.5	61.7	56	119.5	100.3	16	165.5	138.8	76	211.4	177.4
37	28.3	23.8	97	74.3	62.4	57	120.3	100.9	17	166.2	139.5	77	212.2	178.1
38	29.1	24.4	98	75.1	63.0	58	121.0	101.6	18	167.0	140.1	78	213.0	178.7
39	29.9	25.1	99	75.8	63.6	59	121.8	102.2	19	167.8	140.8	79	213.7	179.3
40	30.6	25.7	100	76.6	64.3	60	122.6	102.8	20	168.5	141.4	80	214.5	180.0
41	31.4	26.4	101	77.4	64.9	161	123.3	103.5	221	169.3	142.1	281	215.3	180.6
42	32.2	27.0	02	78.1	65.6	62	124.1	104.1	22	170.1	142.7	82	216.0	181.3
43	32.9	27.6	03	78.9	66.2	63	124.9	104.8	23	170.8	143.3	83	216.8	181.9
44	33.7	28.3	04	79.7	66.8	64	125.6	105.4	24	171.6	144.0	84	217.6	182.6
45	34.5	28.9	05	80.4	67.5	65	126.4	106.1	25	172.4	144.6	85	218.3	183.2
46	35.2	29.6	06	81.2	68.1	66	127.2	106.7	26	173.1	145.3	86	219.1	183.8
47	36.0	30.2	07	82.0	68.8	67	127.9	107.3	27	173.9	145.9	87	219.9	184.5
48	36.8	30.9	08	82.7	69.4	68	128.7	108.0	28	174.7	146.6	88	220.6	185.1
49	37.5	31.5	09	83.5	70.1	69	129.5	108.6	29	175.4	147.2	89	221.4	185.8
50	38.3	32.1	10	84.3	70.7	70	130.2	109.3	30	176.2	147.8	90	222.2	186.4
51	39.1	32.8	111	85.0	71.3	171	131.0	109.9	231	177.0	148.5	291	222.9	187.1
52	39.8	33.4	12	85.8	72.0	72	131.8	110.6	32	177.7	149.1	92	223.7	187.7
53	40.6	34.1	13	86.6	72.6	73	132.5	111.2	33	178.5	149.8	93	224.4	188.3
54	41.4	34.7	14	87.3	73.3	74	133.3	111.8	34	179.3	150.4	94	225.2	189.0
55	42.1	35.4	15	88.1	73.9	75	134.1	112.5	35	180.0	151.1	95	226.0	189.6
56	42.9	36.0	16	88.9	74.6	76	134.8	113.1	36	180.8	151.7	96	226.7	190.3
57	43.7	36.6	17	89.6	75.2	77	135.6	113.8	37	181.6	152.3	97	227.5	190.9
58	44.4	37.3	18	90.4	75.8	78	136.4	114.4	38	182.3	153.0	98	228.3	191.6
59	45.2	37.9	19	91.2	76.5	79	137.1	115.1	39	183.1	153.6	99	229.0	192.2
60	46.0	38.6	20	91.9	77.1	80	137.9	115.7	40	183.8	154.3	300	229.8	192.8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 50 Degrees.

TABLE II. Difference of Latitude and Departure for 39 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	47.4	38.4	121	94.0	76.1	181	140.7	113.9	241	187.3	151.7
2	01.6	01.3	62	48.2	39.0	22	94.8	76.8	82	141.4	114.5	42	188.1	152.3
3	02.3	01.9	63	49.0	39.6	23	95.6	77.4	83	142.2	115.2	43	188.8	152.9
4	03.1	02.5	64	49.7	40.3	24	96.4	78.0	84	143.0	115.8	44	189.6	153.6
5	03.9	03.1	65	50.5	40.9	25	97.1	78.7	85	143.8	116.4	45	190.4	154.2
6	04.7	03.8	66	51.3	41.5	26	97.9	79.3	86	144.5	117.1	46	191.2	154.8
7	05.4	04.4	67	52.1	42.2	27	98.7	79.9	87	145.3	117.7	47	192.0	155.4
8	06.2	05.0	68	52.8	42.8	28	99.5	80.6	88	146.1	118.3	48	192.7	156.1
9	07.0	05.7	69	53.6	43.4	29	100.3	81.2	89	146.9	118.9	49	193.5	156.7
10	07.8	06.3	70	54.4	44.1	30	101.0	81.8	90	147.7	119.6	50	194.3	157.3
11	08.5	06.9	71	55.2	44.7	131	101.8	82.4	191	148.4	120.2	251	195.1	158.0
12	09.3	07.6	72	56.0	45.3	32	102.6	83.1	92	149.2	120.8	52	195.8	158.6
13	10.1	08.2	73	56.7	45.9	33	103.4	83.7	93	150.0	121.5	53	196.6	159.2
14	10.9	08.8	74	57.5	46.6	34	104.1	84.3	94	150.8	122.1	54	197.4	159.8
15	11.7	09.4	75	58.3	47.2	35	104.9	85.0	95	151.5	122.7	55	198.2	160.5
16	12.4	10.1	76	59.1	47.8	36	105.7	85.6	96	152.3	123.3	56	198.9	161.1
17	13.2	10.7	77	59.8	48.5	37	106.5	86.2	97	153.1	124.0	57	199.7	161.7
18	14.0	11.3	78	60.6	49.1	38	107.2	86.8	98	153.9	124.6	58	200.5	162.4
19	14.8	12.0	79	61.4	49.7	39	108.0	87.5	99	154.7	125.2	59	201.3	163.0
20	15.5	12.6	80	62.2	50.3	40	108.8	88.1	200	155.4	125.9	60	202.1	163.6
21	16.3	13.2	81	62.9	51.0	141	109.0	88.7	201	156.2	126.5	261	202.8	164.3
22	17.1	13.8	82	63.7	51.6	42	110.4	89.4	02	157.0	127.1	62	203.6	164.9
23	17.9	14.5	83	64.5	52.2	43	111.1	90.0	03	157.8	127.8	63	204.4	165.5
24	18.7	15.1	84	65.3	52.9	44	111.9	90.6	04	158.5	128.4	64	205.2	166.1
25	19.4	15.7	85	66.1	53.5	45	112.7	91.3	05	159.3	129.0	65	205.9	166.8
26	20.2	16.4	86	66.8	54.1	46	113.5	91.9	06	160.1	129.6	66	206.7	167.4
27	21.0	17.0	87	67.6	54.8	47	114.2	92.5	07	160.9	130.3	67	207.5	168.0
28	21.8	17.6	88	68.4	55.4	48	115.0	93.1	08	161.6	130.9	68	208.3	168.7
29	22.5	18.3	89	69.2	56.0	49	115.8	93.8	09	162.4	131.5	69	209.1	169.3
30	23.3	18.9	90	69.9	56.6	50	116.6	94.4	10	163.2	132.2	70	209.8	169.9
31	24.1	19.5	91	70.7	57.3	151	117.3	95.0	211	164.0	132.8	271	210.6	170.5
32	24.9	20.1	92	71.5	57.9	52	118.1	95.7	12	164.8	133.4	72	211.4	171.2
33	25.6	20.8	93	72.3	58.5	53	118.9	96.3	13	165.5	134.0	73	212.2	171.8
34	26.4	21.4	94	73.1	59.2	54	119.7	96.9	14	166.3	134.7	74	212.9	172.4
35	27.2	22.0	95	73.8	59.8	55	120.5	97.5	15	167.1	135.3	75	213.7	173.1
36	28.0	22.7	96	74.6	60.4	56	121.2	98.2	16	167.9	135.9	76	214.5	173.7
37	28.8	23.3	97	75.4	61.0	57	122.0	98.8	17	168.6	136.6	77	215.3	174.3
38	29.5	23.9	98	76.2	61.7	58	122.8	99.4	18	169.4	137.2	78	216.0	175.0
39	30.3	24.5	99	76.9	62.3	59	123.6	100.1	19	170.2	137.8	79	216.8	175.6
40	31.1	25.2	100	77.7	62.9	60	124.3	100.7	20	171.0	138.5	80	217.6	176.2
41	31.9	25.8	101	78.5	63.6	161	125.1	101.3	221	171.7	139.1	281	218.4	176.8
42	32.6	26.4	02	79.3	64.2	62	125.9	101.9	22	172.5	139.7	82	219.2	177.5
43	33.4	27.1	03	80.0	64.8	63	126.7	102.6	23	173.3	140.3	83	219.9	178.1
44	34.2	27.7	04	80.8	65.4	64	127.5	103.2	24	174.1	141.0	84	220.7	178.7
45	35.0	28.3	05	81.6	66.1	65	128.2	103.8	25	174.9	141.6	85	221.5	179.4
46	35.7	28.9	06	82.4	66.7	66	129.0	104.5	26	175.6	142.2	86	222.3	180.0
47	36.5	29.6	07	83.2	67.3	67	129.8	105.1	27	176.4	142.9	87	223.0	180.6
48	37.3	30.2	08	83.9	68.0	68	130.6	105.7	28	177.2	143.5	88	223.8	181.2
49	38.1	30.8	09	84.7	68.6	69	131.3	106.4	29	178.0	144.1	89	224.6	181.9
50	38.9	31.5	10	85.5	69.2	70	132.1	107.0	30	178.7	144.7	90	225.4	182.5
51	39.6	32.1	111	86.3	69.9	171	132.9	107.6	231	179.5	145.4	291	226.1	183.1
52	40.4	32.7	12	87.0	70.5	72	133.7	108.2	32	180.3	146.0	92	226.9	183.8
53	41.2	33.4	13	87.8	71.1	73	134.4	108.9	33	181.1	146.6	93	227.7	184.4
54	42.0	34.0	14	88.6	71.7	74	135.2	109.5	34	181.9	147.3	94	228.5	185.0
55	42.7	34.6	15	89.4	72.4	75	136.0	110.1	35	182.6	147.9	95	229.3	185.6
56	43.5	35.2	16	90.1	73.0	76	136.8	110.8	36	183.4	148.5	96	230.0	186.3
57	44.3	35.9	17	90.9	73.6	77	137.6	111.4	37	184.2	149.1	97	230.8	186.9
58	45.1	36.5	18	91.7	74.3	78	138.3	112.0	38	185.0	149.8	98	231.6	187.5
59	45.9	37.1	19	92.5	74.9	79	139.1	112.6	39	185.7	150.4	99	232.4	188.2
60	46.6	37.8	20	93.3	75.5	80	139.9	113.3	40	186.5	151.0	300	233.1	188.8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 51 Degrees.

Difference of Latitude and Departure for 42 Degrees.

ist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
61	45.3	40.8	121	89.9	81.0	181	134.5	121.1	241	179.1	161.3
62	46.1	41.5	22	90.7	81.6	82	135.3	121.8	42	179.8	161.9
63	46.8	42.2	23	91.4	82.3	83	136.0	122.5	43	180.6	162.6
64	47.6	42.8	24	92.1	83.0	84	136.7	123.1	44	181.3	163.3
65	48.3	43.5	25	92.9	83.6	85	137.5	123.8	45	182.1	163.9
66	49.0	44.2	26	93.6	84.3	86	138.2	124.5	46	182.8	164.6
67	49.8	44.8	27	94.4	85.0	87	139.0	125.1	47	183.6	165.3
68	50.5	45.5	28	95.1	85.6	88	139.7	125.8	48	184.3	165.9
69	51.3	46.2	29	95.9	86.3	89	140.5	126.5	49	185.1	166.6
70	52.0	46.8	30	96.6	87.0	90	141.2	127.1	50	185.8	167.3
71	52.8	47.5	131	97.4	87.7	191	141.9	127.8	251	186.5	168.0
72	53.5	48.2	32	98.1	88.3	92	142.7	128.5	52	187.3	168.6
73	54.2	48.8	33	98.8	89.0	93	143.4	129.1	53	188.0	169.3
74	55.0	49.5	34	99.6	89.7	94	144.2	129.8	54	188.8	170.0
75	55.7	50.2	35	100.3	90.3	95	144.9	130.5	55	189.5	170.6
76	56.5	50.8	36	101.1	91.0	96	145.7	131.1	56	190.2	171.3
77	57.2	51.5	37	101.8	91.7	97	146.4	131.8	57	191.0	172.0
78	58.0	52.2	38	102.6	92.3	98	147.1	132.5	58	191.7	172.6
79	58.7	52.9	39	103.3	93.0	99	147.9	133.2	59	192.5	173.3
80	59.5	53.5	40	104.0	93.7	200	148.6	133.8	60	193.2	174.0
81	60.2	54.2	141	104.8	94.3	201	149.4	134.5	261	194.0	174.6
82	60.9	54.9	42	105.5	95.0	02	150.1	135.2	62	194.7	175.3
83	61.7	55.5	43	106.3	95.7	03	150.9	135.8	63	195.4	176.0
84	62.4	56.2	44	107.0	96.4	04	151.6	136.5	64	196.2	176.7
85	63.2	56.9	45	107.8	97.0	05	152.3	137.2	65	196.9	177.3
86	63.9	57.5	46	108.5	97.7	06	153.1	137.8	66	197.7	178.0
87	64.7	58.2	47	109.2	98.4	07	153.8	138.5	67	198.4	178.7
88	65.4	58.9	48	110.0	99.0	08	154.6	139.2	68	199.2	179.3
89	66.1	59.6	49	110.7	99.7	09	155.3	139.8	69	199.9	180.0
90	66.9	60.2	50	111.4	100.4	10	156.1	140.5	70	200.6	180.7
91	67.6	60.9	151	112.2	101.0	211	156.8	141.2	271	201.4	181.3
92	68.4	61.6	52	113.0	101.7	12	157.5	141.9	72	202.1	182.0
93	69.1	62.2	53	113.7	102.4	13	158.3	142.5	73	202.9	182.7

TABLE II. Difference of Latitude and Departure for 41 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.7	61	46.0	40.0	121	91.3	79.4	181	136.6	118.7	241	181.9	158.1
2	01.5	01.3	62	46.8	40.7	22	92.1	80.0	82	137.4	119.4	42	182.6	158.8
3	02.3	02.0	63	47.5	41.3	23	92.8	80.7	83	138.1	120.1	43	183.4	159.4
4	03.0	02.6	64	48.3	42.0	24	93.6	81.4	84	138.9	120.7	44	184.1	160.1
5	03.8	03.3	65	49.1	42.6	25	94.3	82.0	85	139.6	121.4	45	184.9	160.7
6	04.5	03.9	66	49.8	43.3	26	95.1	82.7	86	140.4	122.0	46	185.7	161.4
7	05.3	04.6	67	50.6	44.0	27	95.8	83.3	87	141.1	122.7	47	186.4	162.0
8	06.1	05.2	68	51.3	44.6	28	96.6	84.0	88	141.9	123.3	48	187.2	162.7
9	06.8	05.9	69	52.1	45.3	29	97.4	84.6	89	142.6	124.0	49	187.9	163.4
10	07.5	06.6	70	52.8	45.9	30	98.1	85.3	90	143.4	124.7	50	188.7	164.0
11	08.3	07.2	71	53.6	46.6	131	98.9	85.9	191	144.1	125.3	251	189.4	164.6
12	09.1	07.9	72	54.3	47.2	32	99.6	86.6	92	144.9	126.0	52	190.2	165.3
13	09.8	08.5	73	55.1	47.9	33	100.4	87.3	93	145.7	126.6	53	190.9	166.0
14	10.6	09.2	74	55.8	48.5	34	101.1	87.9	94	146.4	127.3	54	191.7	166.6
15	11.3	09.8	75	56.6	49.2	35	101.9	88.6	95	147.2	127.9	55	192.5	167.3
16	12.1	10.5	76	57.4	49.9	36	102.6	89.2	96	147.9	128.6	56	193.2	168.0
17	12.8	11.2	77	58.1	50.5	37	103.4	89.9	97	148.7	129.2	57	194.0	168.6
18	13.6	11.8	78	58.9	51.2	38	104.1	90.5	98	149.4	129.9	58	194.7	169.3
19	14.3	12.5	79	59.6	51.8	39	104.9	91.2	99	150.2	130.6	59	195.5	169.9
20	15.1	13.1	80	60.4	52.5	40	105.7	91.8	200	150.9	131.2	60	196.2	170.5
21	15.8	13.8	81	61.1	53.1	141	106.4	92.5	201	151.7	131.9	261	197.0	171.2
22	16.6	14.4	82	61.9	53.8	42	107.2	93.2	02	152.5	132.5	62	197.7	171.9
23	17.4	15.1	83	62.6	54.5	43	107.9	93.8	03	153.2	133.2	63	198.5	172.5
24	18.1	15.7	84	63.4	55.1	44	108.7	94.5	04	154.0	133.8	64	199.2	173.2
25	18.9	16.4	85	64.2	55.8	45	109.4	95.1	05	154.7	134.5	65	200.0	173.9
26	19.6	17.1	86	64.9	56.4	46	110.2	95.8	06	155.5	135.1	66	200.8	174.5
27	20.4	17.7	87	65.7	57.1	47	110.9	96.4	07	156.2	135.8	67	201.5	175.2
28	21.1	18.4	88	66.4	57.7	48	111.7	97.1	08	157.0	136.5	68	202.3	175.8
29	21.9	19.0	89	67.2	58.4	49	112.5	97.8	09	157.7	137.1	69	203.0	176.5
30	22.6	19.7	90	67.9	59.0	50	113.2	98.4	10	158.5	137.8	70	203.8	177.1
31	23.4	20.3	91	68.7	59.7	151	114.0	99.1	211	159.2	138.4	271	204.5	177.8
32	24.2	21.0	92	69.4	60.4	52	114.7	99.7	12	160.0	139.1	72	205.3	178.4
33	24.9	21.6	93	70.2	61.0	53	115.5	100.4	13	160.8	139.7	73	206.0	179.1
34	25.7	22.3	94	70.9	61.7	54	116.2	101.0	14	161.5	140.4	74	206.8	179.8
35	26.4	23.0	95	71.7	62.3	55	117.0	101.7	15	162.3	141.1	75	207.5	180.4
36	27.2	23.6	96	72.5	63.0	56	117.7	102.3	16	163.0	141.7	76	208.3	181.1
37	27.9	24.3	97	73.2	63.6	57	118.5	103.0	17	163.8	142.4	77	209.1	181.7
38	28.7	24.9	98	74.0	64.3	58	119.2	103.7	18	164.5	143.0	78	209.8	182.4
39	29.4	25.6	99	74.7	64.9	59	120.0	104.3	19	165.3	143.7	79	210.6	183.0
40	30.2	26.2	100	75.5	65.6	60	120.8	105.0	20	166.0	144.3	80	211.3	183.7
41	30.9	26.9	101	76.2	66.3	161	121.5	105.6	221	166.8	145.0	281	212.1	184.4
42	31.7	27.6	02	77.0	66.9	62	122.3	106.3	22	167.5	145.6	82	212.8	185.0
43	32.5	28.2	03	77.7	67.6	63	123.0	106.9	23	168.3	146.3	83	213.6	185.7
44	33.2	28.9	04	78.5	68.2	64	123.8	107.6	24	169.1	147.0	84	214.3	186.3
45	34.0	29.5	05	79.2	68.9	65	124.5	108.2	25	169.8	147.6	85	215.1	187.0
46	34.7	30.2	06	80.0	69.5	66	125.3	108.9	26	170.6	148.3	86	215.8	187.6
47	35.5	30.8	07	80.8	70.2	67	126.0	109.6	27	171.3	148.9	87	216.6	188.3
48	36.2	31.5	08	81.5	70.9	68	126.8	110.2	28	172.1	149.6	88	217.4	188.9
49	37.0	32.1	09	82.3	71.5	69	127.5	110.9	29	172.8	150.2	89	218.1	189.6
50	37.7	32.8	10	83.0	72.2	70	128.3	111.5	30	173.6	150.9	90	218.9	190.3
51	38.5	33.5	111	83.8	72.8	171	129.1	112.2	231	174.3	151.5	291	219.6	190.9
52	39.2	34.1	12	84.5	73.5	72	129.8	112.8	32	175.1	152.2	92	220.4	191.6
53	40.0	34.8	13	85.3	74.1	73	130.6	113.5	33	175.8	152.9	93	221.1	192.2
54	40.8	35.4	14	86.0	74.8	74	131.3	114.2	34	176.6	153.5	94	221.9	192.9
55	41.5	36.1	15	86.8	75.4	75	132.1	114.8	35	177.4	[illegible]	95	222.6	193.5
56	42.3	36.7	16	87.5	76.1	76	132.8	115.5	36	178.1	[illegible]	96	223.4	194.2
57	43.0	37.4	17	88.3	76.8	77	133.6	116.1	37	[illegible]	[illegible]	97	224.1	194.8
58	43.8	38.1	18	89.1	77.4	78	134.3	116.8	38	[illegible]	[illegible]	98	224.9	195.5
59	44.5	38.7	19	89.8	78.1	79	135.1	117.4	39	180.4	156.8	99	225.7	196.2
60	45.3	39.4	20	90.6	78.7	80	135.8	118.1	40	181.1	157.5	300	[illegible]	196.8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 49 Degrees

11 h

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
61	43.9	42.4	121	87.0	84.1	181	130.2	125.7	241	173.4	167.4
62	44.6	43.1	22	87.8	84.7	82	130.9	126.4	42	174.1	168.1
63	45.3	43.8	23	88.5	85.4	83	131.6	127.1	43	174.8	168.8
64	46.0	44.5	24	89.2	86.1	84	132.4	127.8	44	175.5	169.5
65	46.8	45.2	25	89.9	86.8	85	133.1	128.5	45	176.2	170.2
66	47.5	45.8	26	90.6	87.5	86	133.8	129.2	46	177.0	170.9
67	48.2	46.5	27	91.4	88.2	87	134.5	129.9	47	177.7	171.6
68	48.9	47.2	28	92.1	88.9	88	135.2	130.6	48	178.4	172.3
69	49.6	47.9	29	92.8	89.6	89	136.0	131.3	49	179.1	173.0
70	50.4	48.6	30	93.5	90.3	90	136.7	132.0	50	179.8	173.7
71	51.1	49.3	131	94.2	91.0	191	137.4	132.7	251	180.6	174.4
72	51.8	50.0	32	95.0	91.7	92	138.1	133.4	52	181.3	175.1
73	52.5	50.7	33	95.7	92.4	93	138.8	134.1	53	182.0	175.7
74	53.2	51.4	34	96.4	93.1	94	139.6	134.8	54	182.7	176.4
75	54.0	52.1	35	97.1	93.8	95	140.3	135.5	55	183.4	177.1
76	54.7	52.8	36	97.8	94.5	96	141.0	136.2	56	184.2	177.8
77	55.4	53.5	37	98.5	95.2	97	141.7	136.8	57	184.9	178.5
78	56.1	54.2	38	99.3	95.9	98	142.4	137.5	58	185.6	179.2
79	56.8	54.9	39	100.0	96.6	99	143.1	138.2	59	186.3	179.9
80	57.5	55.6	40	100.7	97.3	200	143.9	138.9	60	187.0	180.6
81	58.3	56.3	141	101.4	97.9	201	144.6	139.6	261	187.7	181.3
82	59.0	57.0	42	102.1	98.6	02	145.3	140.3	62	188.5	182.0
83	59.7	57.7	43	102.9	99.3	03	146.0	141.0	63	189.2	182.7
84	60.4	58.4	44	103.6	100.0	04	146.7	141.7	64	189.9	183.4
85	61.1	59.0	45	104.3	100.7	05	147.5	142.4	65	190.6	184.1
86	61.9	59.7	46	105.0	101.4	06	148.2	143.1	66	191.3	184.8
87	62.6	60.4	47	105.7	102.1	07	148.9	143.8	67	192.1	185.5
88	63.3	61.1	48	106.5	102.8	08	149.6	144.5	68	192.8	186.2
89	64.0	61.8	49	107.2	103.5	09	150.3	145.2	69	193.5	186.9
90	64.7	62.5	50	107.9	104.2	10	151.1	145.9	70	194.2	187.6
91	65.5	63.2	151	108.6	104.9	211	151.8	146.6	271	194.9	188.3
92	66.2	63.9	52	109.3	105.6	12	152.5	147.3	72	195.7	188.9

TABLE II. Difference of Latitude and Departure for 45 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.7	00.7	61	43.1	43.1	121	85.6	85.6	181	128.0	128.0	241	170.4	170.4
2	01.4	01.4	62	43.8	43.8	22	86.3	86.3	82	128.7	128.7	42	171.1	171.1
3	02.1	02.1	63	44.5	44.5	23	87.0	87.0	83	129.4	129.4	43	171.8	171.8
4	02.8	02.8	64	45.3	45.3	24	87.7	87.7	84	130.1	130.1	44	172.5	172.5
5	03.5	03.5	65	46.0	46.0	25	88.4	88.4	85	130.8	130.8	45	173.2	173.2
6	04.2	04.2	66	46.7	46.7	26	89.1	89.1	86	131.5	131.5	46	173.9	173.9
7	04.9	04.9	67	47.4	47.4	27	89.8	89.8	87	132.2	132.2	47	174.7	174.7
8	05.7	05.7	68	48.1	48.1	28	90.5	90.5	88	132.9	132.9	48	175.4	175.4
9	06.4	06.4	69	48.8	48.8	29	91.2	91.2	89	133.6	133.6	49	176.1	176.1
10	07.1	07.1	70	49.5	49.5	30	91.9	91.9	90	134.4	134.4	50	176.8	176.8
11	07.8	07.8	71	50.2	50.2	131	92.6	92.6	191	135.1	135.1	251	177.5	177.5
12	08.5	08.5	72	50.9	50.9	32	93.3	93.3	92	135.8	135.8	52	178.2	178.2
13	09.2	09.2	73	51.6	51.6	33	94.0	94.0	93	136.5	136.5	53	178.9	178.9
14	09.9	09.9	74	52.3	52.3	34	94.8	94.8	94	137.2	137.2	54	179.6	179.6
15	10.6	10.6	75	53.0	53.0	35	95.5	95.5	95	137.9	137.9	55	180.3	180.3
16	11.3	11.3	76	53.7	53.7	36	96.2	96.2	96	138.6	138.6	56	181.0	181.0
17	12.0	12.0	77	54.4	54.4	37	96.9	96.9	97	139.3	139.3	57	181.7	181.7
18	12.7	12.7	78	55.2	55.2	38	97.6	97.6	98	140.0	140.0	58	182.4	182.4
19	13.4	13.4	79	55.9	55.9	39	98.3	98.3	99	140.7	140.7	59	183.1	183.1
20	14.1	14.1	80	56.6	56.6	40	99.0	99.0	200	141.4	141.4	60	183.8	183.8
21	14.8	14.8	81	57.3	57.3	141	99.7	99.7	201	142.1	142.1	261	184.6	184.6
22	15.6	15.6	82	58.0	58.0	42	100.4	100.4	02	142.8	142.8	62	185.3	185.3
23	16.3	16.3	83	58.7	58.7	43	101.1	101.1	03	143.5	143.5	63	186.0	186.0
24	17.0	17.0	84	59.4	59.4	44	101.8	101.8	04	144.2	144.2	64	186.7	186.7
25	17.7	17.7	85	60.1	60.1	45	102.5	102.5	05	145.0	145.0	65	187.4	187.4
26	18.4	18.4	86	60.8	60.8	46	103.2	103.2	06	145.7	145.7	66	188.1	188.1
27	19.1	19.1	87	61.5	61.5	47	103.9	103.9	07	146.4	146.4	67	188.8	188.8
28	19.8	19.8	88	62.2	62.2	48	104.7	104.7	08	147.1	147.1	68	189.5	189.5
29	20.5	20.5	89	62.9	62.9	49	105.4	105.4	09	147.8	147.8	69	190.2	190.2
30	21.2	21.2	90	63.6	63.6	50	106.1	106.1	10	148.5	148.5	70	190.9	190.9
31	21.9	21.9	91	64.3	64.3	151	106.8	106.8	211	149.2	149.2	271	191.6	191.6
32	22.6	22.6	92	65.1	65.1	52	107.5	107.5	12	149.9	149.9	72	192.3	192.3
33	23.3	23.3	93	65.8	65.8	53	108.2	108.2	13	150.6	150.6	73	193.0	193.0
34	24.0	24.0	94	66.5	66.5	54	108.9	108.9	14	151.3	151.3	74	193.7	193.7
35	24.7	24.7	95	67.2	67.2	55	109.6	109.6	15	152.0	152.0	75	194.5	194.5
36	25.5	25.5	96	67.9	67.9	56	110.3	110.3	16	152.7	152.7	76	195.2	195.2
37	26.2	26.2	97	68.6	68.6	57	111.0	111.0	17	153.4	153.4	77	195.9	195.9
38	26.9	26.9	98	69.3	69.3	58	111.7	111.7	18	154.1	154.1	78	196.6	196.6
39	27.6	27.6	99	70.0	70.0	59	112.4	112.4	19	154.9	154.9	79	197.3	197.3
40	28.3	28.3	100	70.7	70.7	60	113.1	113.1	20	155.6	155.6	80	198.0	198.0
41	29.0	29.0	101	71.4	71.4	161	113.8	113.8	221	156.3	156.3	281	198.7	198.7
42	29.7	29.7	02	72.1	72.1	62	114.6	114.6	22	157.0	157.0	82	199.4	199.4
43	30.4	30.4	03	72.8	72.8	63	115.3	115.3	23	157.7	157.7	83	200.1	200.1
44	31.1	31.1	04	73.5	73.5	64	116.0	116.0	24	158.4	158.4	84	200.8	200.8
45	31.8	31.8	05	74.2	74.2	65	116.7	116.7	25	159.1	159.1	85	201.5	201.5
46	32.5	32.5	06	75.0	75.0	66	117.4	117.4	26	159.8	159.8	86	202.2	202.2
47	33.2	33.2	07	75.7	75.7	67	118.1	118.1	27	160.5	160.5	87	202.9	202.9
48	33.9	33.9	08	76.4	76.4	68	118.8	118.8	28	161.2	161.2	88	203.6	203.6
49	34.6	34.6	09	77.1	77.1	69	119.5	119.5	29	161.9	161.9	89	204.4	204.4
50	35.4	35.4	10	77.8	77.8	70	120.2	120.2	30	162.6	162.6	90	205.1	205.1
51	36.1	36.1	111	78.5	78.5	171	120.9	120.9	231	163.3	163.3	291	205.8	205.8
52	36.8	36.8	12	79.2	79.2	72	121.6	121.6	32	164.0	164.0	92	206.5	206.5
53	37.5	37.5	13	79.9	79.9	73	122.3	122.3	33	164.8	164.8	93	207.2	207.2
54	38.2	38.2	14	80.6	80.6	74	123.0	123.0	34	165.5	165.5	94	207.9	207.9
55	38.9	38.9	15	81.3	81.3	75	123.7	123.7	35	166.2	166.2	95	208.6	208.6
56	39.6	39.6	16	82.0	82.0	76	124.5	124.5	36	166.9	166.9	96	209.3	209.3
57	40.3	40.3	17	82.7	82.7	77	125.2	125.2	37	167.6	167.6	97	210.0	210.0
58	41.0	41.0	18	83.4	83.4	78	125.9	125.9	38	168.3	168.3	98	210.7	210.7
59	41.7	41.7	19	84.1	84.1	79	126.6	126.6	39	169.0	169.0	99	211.4	211.4
60	42.4	42.4	20	84.9	84.9	80	127.3	127.3	40	169.7	169.7	300	212.1	212.1
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 45 Degrees.

ithmic Sines, Tangents, and Secants, to every Point and Quarter-Point of the Compass.

Co-sines.	Tangents.	Co-tang.	Secant.	Co-secant.	Points.
10. 00000	0. 00000	Infinite.	10. 00000	Infinite.	8
9. 99947	8. 69132	11. 30868	10. 00052	11. 30921	7 ¾
9. 99790	8. 99340	11. 00660	10. 00210	11. 00870	7 ½
9. 99527	9. 17125	10. 82875	10. 00473	10. 83348	7 ¼
9. 99157	9. 29866	10. 70134	10. 00843	10. 70976	7
9. 98679	9. 39878	10. 60122	10. 01321	10. 61443	6 ¾
9. 98088	9. 48194	10. 51806	10. 01912	10. 53718	6 ½
9. 97384	9. 55365	10. 44635	10. 02616	10. 47251	6 ¼
9. 96562	9. 61722	10. 38278	10. 03438	10. 41716	6
9. 95616	9. 67483	10. 32517	10. 04384	10. 36901	5 ¾
9. 94543	9. 72796	10. 27204	10. 05457	10. 32661	5 ½
9. 93335	9. 77770	10. 22230	10. 06665	10. 28895	5 ¼
9. 91985	9. 82489	10. 17511	10. 08015	10. 25526	5
9. 90483	9. 87020	10. 12980	10. 09517	10. 22497	4 ¾
9. 88819	9. 91417	10. 08583	10. 11181	10. 19764	4 ½
9. 86979	9. 95729	10. 04271	10. 13021	10. 17292	4 ¼
9. 84948	10. 00000	10. 00000	10. 15052	10. 15052	4

TABLE II. Difference of Latitude and Departure for 45 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.7	00.7	61	43.1	43.1	121	85.6	85.6	181	128.0	128.0	241	170.4	170.4
2	01.4	01.4	62	43.8	43.8	22	86.3	86.3	82	128.7	128.7	42	171.1	171.1
3	02.1	02.1	63	44.5	44.5	23	87.0	87.0	83	129.4	129.4	43	171.8	171.8
4	02.8	02.8	64	45.3	45.3	24	87.7	87.7	84	130.1	130.1	44	172.5	172.5
5	03.5	03.5	65	46.0	46.0	25	88.4	88.4	85	130.8	130.8	45	173.2	173.2
6	04.2	04.2	66	46.7	46.7	26	89.1	89.1	86	131.5	131.5	46	173.9	173.9
7	04.9	04.9	67	47.4	47.4	27	89.8	89.8	87	132.2	132.2	47	174.7	174.7
8	05.7	05.7	68	48.1	48.1	28	90.5	90.5	88	132.9	132.9	48	175.4	175.4
9	06.4	06.4	69	48.8	48.8	29	91.2	91.2	89	133.6	133.6	49	176.1	176.1
10	07.1	07.1	70	49.5	49.5	30	91.9	91.9	90	134.4	134.4	50	176.8	176.8
11	07.8	07.8	71	50.2	50.2	131	92.6	92.6	191	135.1	135.1	251	177.5	177.5
12	08.5	08.5	72	50.9	50.9	32	93.3	93.3	92	135.8	135.8	52	178.2	178.2
13	09.2	09.2	73	51.6	51.6	33	94.0	94.0	93	136.5	136.5	53	178.9	178.9
14	09.9	09.9	74	52.3	52.3	34	94.8	94.8	94	137.2	137.2	54	179.6	179.6
15	10.6	10.6	75	53.0	53.0	35	95.5	95.5	95	137.9	137.9	55	180.3	180.3
16	11.3	11.3	76	53.7	53.7	36	96.2	96.2	96	138.6	138.6	56	181.0	181.0
17	12.0	12.0	77	54.4	54.4	37	96.9	96.9	97	139.3	139.3	57	181.7	181.7
18	12.7	12.7	78	55.2	55.2	38	97.6	97.6	98	140.0	140.0	58	182.4	182.4
19	13.4	13.4	79	55.9	55.9	39	98.3	98.3	99	140.7	140.7	59	183.1	183.1
20	14.1	14.1	80	56.6	56.6	40	99.0	99.0	200	141.4	141.4	60	183.8	183.8
21	14.8	14.8	81	57.3	57.3	141	99.7	99.7	201	142.1	142.1	261	184.6	184.6
22	15.6	15.6	82	58.0	58.0	42	100.4	100.4	02	142.8	142.8	62	185.3	185.3
23	16.3	16.3	83	58.7	58.7	43	101.1	101.1	03	143.5	143.5	63	186.0	186.0
24	17.0	17.0	84	59.4	59.4	44	101.8	101.8	04	144.2	144.2	64	186.7	186.7
25	17.7	17.7	85	60.1	60.1	45	102.5	102.5	05	145.0	145.0	65	187.4	187.4
26	18.4	18.4	86	60.8	60.8	46	103.2	103.2	06	145.7	145.7	66	188.1	188.1
27	19.1	19.1	87	61.5	61.5	47	103.9	103.9	07	146.4	146.4	67	188.8	188.8
28	19.8	19.8	88	62.2	62.2	48	104.7	104.7	08	147.1	147.1	68	189.5	189.5
29	20.5	20.5	89	62.9	62.9	49	105.4	105.4	09	147.8	147.8	69	190.2	190.2
30	21.2	21.2	90	63.6	63.6	50	106.1	106.1	10	148.5	148.5	70	190.9	190.9
31	21.9	21.9	91	64.3	64.3	151	106.8	106.8	211	149.2	149.2	271	191.6	191.6
32	22.6	22.6	92	65.1	65.1	52	107.5	107.5	12	149.9	149.9	72	192.3	192.3
33	23.3	23.3	93	65.8	65.8	53	108.2	108.2	13	150.6	150.6	73	193.0	193.0
34	24.0	24.0	94	66.5	66.5	54	108.9	108.9	14	151.3	151.3	74	193.7	193.7
35	24.7	24.7	95	67.2	67.2	55	109.6	109.6	15	152.0	152.0	75	194.5	194.5
36	25.5	25.5	96	67.9	67.9	56	110.3	110.3	16	152.7	152.7	76	195.2	195.2
37	26.2	26.2	97	68.6	68.6	57	111.0	111.0	17	153.4	153.4	77	195.9	195.9
38	26.9	26.9	98	69.3	69.3	58	111.7	111.7	18	154.1	154.1	78	196.6	196.6
39	27.6	27.6	99	70.0	70.0	59	112.4	112.4	19	154.9	154.9	79	197.3	197.3
40	28.3	28.3	100	70.7	70.7	60	113.1	113.1	20	155.6	155.6	80	198.0	198.0
41	29.0	29.0	101	71.4	71.4	161	113.8	113.8	221	156.3	156.3	281	198.7	198.7
42	29.7	29.7	02	72.1	72.1	62	114.6	114.6	22	157.0	157.0	82	199.4	199.4
43	30.4	30.4	03	72.8	72.8	63	115.3	115.3	23	157.7	157.7	83	200.1	200.1
44	31.1	31.1	04	73.5	73.5	64	116.0	116.0	24	158.4	158.4	84	200.8	200.8
45	31.8	31.8	05	74.2	74.2	65	116.7	116.7	25	159.1	159.1	85	201.5	201.5
46	32.5	32.5	06	75.0	75.0	66	117.4	117.4	26	159.8	159.8	86	202.2	202.2
47	33.2	33.2	07	75.7	75.7	67	118.1	118.1	27	160.5	160.5	87	202.9	202.9
48	33.9	33.9	08	76.4	76.4	68	118.8	118.8	28	161.2	161.2	88	203.6	203.6
49	34.6	34.6	09	77.1	77.1	69	119.5	119.5	29	161.9	161.9	89	204.4	204.4
50	35.4	35.4	10	77.8	77.8	70	120.2	120.2	30	162.6	162.6	90	205.1	205.1
51	36.1	36.1	111	78.5	78.5	171	120.9	120.9	231	163.3	163.3	291	205.8	205.8
52	36.8	36.8	12	79.2	79.2	72	121.6	121.6	32	164.0	164.0	92	206.5	206.5
53	37.5	37.5	13	79.9	79.9	73	122.3	122.3	33	164.8	164.8	93	207.2	207.2
54	38.2	38.2	14	80.6	80.6	74	123.0	123.0	34	165.5	165.5	94	207.9	207.9
55	38.9	38.9	15	81.3	81.3	75	123.7	123.7	35	166.2	166.2	95	208.6	208.6
56	39.6	39.6	16	82.0	82.0	76	124.5	124.5	36	166.9	166.9	96	209.3	209.3
57	40.3	40.3	17	82.7	82.7	77	125.2	125.2	37	167.6	167.6	97	210.0	210.0
58	41.0	41.0	18	83.4	83.4	78	125.9	125.9	38	168.3	168.3	98	210.7	210.7
59	41.7	41.7	19	84.1	84.1	79	126.6	126.6	39	169.0	169.0	99	211.4	211.4
60	42.4	42.4	20	84.9	84.9	80	127.3	127.3	40	169.7	169.7	300	212.1	212.1
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 45 Degrees.

TABLE IV.

A Table of Logarithms from 1 to 10,000.

	2	3	4	5	6	7	8	9
39	2.20466	2.20493	2.20520	2.20548	2.20575	2.20602	2.20629	2.20656
10	20737	20763	20790	20817	20844	20871	20898	20925
78	21005	21032	21059	21085	21112	21139	21165	21192
45	21272	21299	21325	21352	21378	21405	21431	21458
11	21537	21564	21590	21617	21643	21669	21696	21722
75	21801	21827	21854	21880	21906	21932	21958	21985
37	22063	22089	22115	22141	22167	22194	22220	22246
98	22324	22350	22376	22401	22427	22453	22479	22505
57	22583	22608	22634	22660	22686	22712	22737	22763
14	22840	22866	22891	22917	22943	22968	22994	23019
70	2.23096	2.23121	2.23147	2.23172	2.23198	2.23223	2.23249	2.23274
25	23350	23376	23401	23426	23452	23477	23502	23528
78	23603	23629	23654	23679	23704	23729	23754	23779
30	23855	23880	23905	23930	23955	23980	24005	24030
80	24105	24130	24155	24180	24204	24229	24254	24279
29	24353	24378	24403	24428	24452	24477	24502	24527
76	24601	24625	24650	24674	24699	24724	24748	24773
22	24846	24871	24895	24920	24944	24969	24993	25018
66	25091	25115	25139	25164	25188	25212	25237	25261
10	25334	25358	25382	25406	25431	25455	25479	25503
51	2.25575	2.25600	2.25624	2.25648	2.25672	2.25696	2.25720	2.25744
92	25816	25840	25864	25888	25912	25935	25959	25983
31	26055	26079	26102	26126	26150	26174	26198	26221
69	26293	26316	26340	26364	26387	26411	26435	26458
05	26529	26553	26576	26600	26623	26647	26670	26694
41	26764	26788	26811	26834	26858	26881	26905	26928
75	26998	27021	27045	27068	27091	27114	27138	27161
07	27231	27254	27277	27300	27323	27346	27370	27393
39	27462	27485	27508	27531	27554	27577	27600	27623

TABLE IV.

A Table of Logarithms from 1 to 10,000.

N°	0	1	2	3	4	5	6	7	8	9
100	2.00000	2.00043	2.00087	2.00130	2.00173	2.00217	2.00260	2.00303	2.00346	2.00389
01	00432	00475	00518	00561	00604	00647	00689	00732	00775	00817
02	00860	00903	00945	00988	01030	01072	01115	01157	01199	01242
03	01284	01325	01368	01410	01452	01494	01536	01578	01620	01662
04	01703	01745	01787	01828	01870	01912	01953	01995	02036	02078
05	02119	02160	02202	02243	02284	02325	02366	02407	02449	02490
06	02531	02572	02612	02653	02694	02735	02776	02816	02857	02898
07	02938	02979	03019	03060	03100	03141	03181	03222	03262	03302
08	03342	03383	03423	03463	03503	03543	03583	03623	03663	03703
09	03743	03782	03822	03862	03902	03941	03981	04021	04060	04100
110	2.04139	2.04179	2.04218	2.04258	2.04297	2.04336	2.04376	2.04415	2.04454	2.04493
11	04532	04571	04610	04650	04689	04727	04766	04805	04844	04883
12	04922	04961	04999	05038	05077	05115	05154	05192	05231	05269
13	05308	05346	05385	05423	05461	05500	05538	05576	05614	05652
14	05690	05729	05767	05805	05843	05881	05918	05956	05994	06032
15	06070	06108	06145	06183	06221	06258	06296	06333	06371	06408
16	06446	06483	06521	06558	06593	06633	06670	06707	06744	06781
17	06819	06856	06893	06930	06967	07004	07041	07078	07115	07151
18	07188	07225	07262	07298	07335	07372	07408	07445	07482	07518
19	07555	07591	07628	07664	07700	07737	07773	07809	07846	07882
120	2.07918	2.07954	2.07990	2.08027	2.08063	2.08099	2.08135	2.08171	2.08207	2.08243
21	08279	08314	08350	08386	08422	08458	08493	08529	08565	08600
22	08636	08672	08707	08743	08778	08814	08849	08884	08920	08955
23	08991	09026	09061	09096	09132	09167	09202	09237	09272	09307
24	09342	09377	09412	09447	09482	09517	09552	09587	09621	09656
25	09691	09726	09760	09795	09830	09864	09899	09934	09968	10003
26	10037	10072	10106	10140	10175	10209	10243	10278	10312	10346
27	10380	10415	10449	10483	10517	10551	10585	10619	10653	10687
28	10721	10755	10789	10823	10857	10890	10924	10958	10992	11025
29	11059	11093	11126	11160	11193	11227	11261	11294	11327	11361
130	2.11394	2.11428	2.11461	2.11494	2.11528	2.11561	2.11594	2.11628	2.11661	2.11694
31	11727	11760	11793	11826	11860	11893	11926	11959	11992	12024
32	12057	12090	12123	12156	12189	12222	12254	12287	12320	12352
33	12385	12418	12450	12483	12516	12548	12581	12613	12646	12678
34	12710	12743	12775	12808	12840	12872	12905	12937	12969	13001
35	13033	13066	13098	13130	13162	13194	13226	13258	13290	13322
36	13354	13386	13418	13450	13481	13513	13545	13577	13609	13640
37	13672	13704	13735	13767	13799	13830	13862	13893	13925	13956
38	13988	14019	14051	14082	14114	14145	14176	14208	14239	14270
39	14301	14333	14364	14395	14426	14457	14489	14520	14551	14582
140	2.14613	2.14644	2.14675	2.14706	2.14737	2.14768	2.14799	2.14829	2.14860	2.14891
41	14922	14953	14983	15014	15045	15076	15106	15137	15168	15198
42	15229	15259	15290	15320	15351	15381	15412	15442	15473	15503
43	15534	15564	15594	15625	15655	15685	15715	15746	15776	15806
44	15836	15866	15897	15927	15957	15987	16017	16047	16077	16107
45	16137	16167	16197	16227	16256	16286	16316	16346	16376	16406
46	16435	16465	16495	16524	16554	16584	16613	16643	16673	16702
47	16732	16761	16791	16820	16850	16879	16909	16938	16967	16997
48	17026	17056	17085	17114	17143	17173	17202	17231	17260	17289
49	17319	17348	17377	17406	17435	17464	17493	17522	17551	17580
150	2.17609	2.17638	2.17667	2.17696	2.17725	2.17754	2.17782	2.17811	2.17840	2.17869
51	17898	17926	17955	17984	18013	18041	18070	18099	18127	18156
52	18184	18213	18241	18270	18298	18327	18355	18384	18412	18441
53	18469	18498	18526	18554	18583	18611	18639	18667	18696	18724
54	18752	18780	18808	18837	18865	18893	18921	18949	18977	19005
55	19033	19061	19089	19117	19145	19173	19201	19229	19257	19285
56	19312	19340	19368	19396	19424	19451	19479	19507	19535	19562
57	19590	19618	19645	19673	19700	19728	19756	19783	19811	19838
58	19866	19893	19921	19948	19976	20003	20030	20058	20085	20112
59	20140	20167	20194	20222	20249	20276	20303	20330	20358	20385

TABLE IV.

A Table of Logarithms from 1 to 10,000.

2	3	4	5	6	7	8	9
2.20466	2.20493	2.20520	2.20548	2.20575	2.20602	2.20629	2.20656
20737	20763	20790	20817	20844	20871	20898	20925
21005	21032	21059	21085	21112	21139	21165	21192
21272	21299	21325	21352	21378	21405	21431	21458
21537	21564	21590	21617	21643	21669	21696	21722
21801	21827	21854	21880	21906	21932	21958	21985
22063	22089	22115	22141	22167	22194	22220	22246
22324	22350	22376	22401	22427	22453	22479	22505
22583	22608	22634	22660	22686	22712	22737	22763
22840	22866	22891	22917	22943	22968	22994	23019
2.23096	2.23121	2.23147	2.23172	2.23198	2.23223	2.23249	2.23274
23350	23376	23401	23426	23452	23477	23502	23528
23603	23629	23654	23679	23704	23729	23754	23779
23855	23880	23905	23930	23955	23980	24005	24030
24105	24130	24155	24180	24204	24229	24254	24279
24353	24378	24403	24428	24452	24477	24502	24527
24601	24625	24650	24674	24699	24724	24748	24773
24846	24871	24895	24920	24944	24969	24993	25018
25091	25115	25139	25164	25188	25212	25237	25261
25334	25358	25382	25406	25431	25455	25479	25503
2.25575	2.25600	2.25624	2.25648	2.25672	2.25696	2.25720	2.25744
25816	25840	25864	25888	25912	25935	25959	25983
26055	26079	26102	26126	26150	26174	26198	26221
26293	26316	26340	26364	26387	26411	26435	26458
26529	26553	26576	26600	26623	26647	26670	26694
26764	26788	26811	26834	26858	26881	26905	26928
26998	27021	27045	27068	27091	27114	27138	27161
27231	27254	27277	27300	27323	27346	27370	27393
27462	27485	27508	27531	27554	27577	27600	27623

TABLE IV.

A Table of Logarithms from 1 to 10,000.

N	0	1	2	3	4	5	6	7	8	9
820	2.91381	2.91387	2.91392	2.91397	2.91403	2.91408	2.91413	2.91418	2.91424	2.91429
21	91434	91440	91445	91450	91455	91461	91466	91471	91477	91482
22	91487	91492	91498	91503	91508	91514	91519	91524	91529	91535
23	91540	91545	91551	91556	91561	91566	91572	91577	91582	91587
24	91593	91598	91603	91609	91614	91619	91624	91630	91635	91640
25	91645	91651	91656	91661	91666	91672	91677	91682	91687	91693
26	91698	91703	91709	91714	91719	91724	91730	91735	91740	91745
27	91751	91756	94761	91766	91772	91777	91782	91787	91793	91798
28	91803	91808	91814	91819	91824	91829	91834	91840	91845	91850
29	91855	91861	91866	91871	91876	91882	91887	91892	91897	91903
830	2.91908	2.91913	2.91918	2.91924	2.91929	2.91934	2.91939	2.91944	2.91950	2.91955
31	91960	91965	91971	91976	91981	91986	91991	91997	92002	92007
32	92012	92018	92023	92028	92033	92038	92044	92049	92054	92059
33	92065	92070	92075	92080	92085	92091	92096	92101	92106	92111
34	92117	92122	92127	92132	92137	92143	92148	92153	92158	92163
35	92169	92174	92179	92184	92189	92195	92200	92205	92210	92215
36	92221	92226	92231	92236	92241	92247	92252	92257	92262	92267
37	92273	92278	92283	92288	92293	92298	92304	92309	92314	92319
38	92324	92330	92335	92340	92345	92350	92355	92361	92366	92371
39	92376	92381	92387	92392	92397	92402	92407	92412	92418	92423
840	2.92428	2.92433	2.92438	2.92443	2.92449	2.92454	2.92459	2.92464	2.92469	2.92474
41	92480	92485	92490	92495	92500	92505	92511	92516	92521	92526
42	92531	92536	92542	92547	92552	92557	92562	92567	92572	92578
43	92583	92588	92593	92598	92603	92609	92614	92619	92624	92629
44	92634	92639	92645	92650	92655	92660	92665	92670	92675	92681
45	92686	92691	92696	92701	92706	92711	92716	92722	92727	92732
46	92737	92742	92747	92752	92758	92763	92768	92773	92778	92783
47	92788	92793	92799	92804	92809	92814	92819	92824	92829	92834
48	92840	92845	92850	92855	92860	92865	92870	92875	92881	92886
49	92891	92896	92901	92906	92911	92916	92921	92927	92932	92937
850	2.92942	2.92947	2.92952	2.92957	2.92962	2.92967	2.92973	2.92978	2.92983	2.92988
51	92993	92998	93003	93008	93013	93018	93024	93029	93034	93039
52	93044	93049	93054	93059	93064	93069	93075	93080	93085	93090
53	93095	93100	93105	93110	93115	93120	93125	93131	93136	93141
54	93146	93151	93156	93161	93166	93171	93176	93181	93186	93192
55	93197	93202	93207	93212	93217	93222	93227	93232	93237	93242
56	93247	93252	93258	93263	93268	93273	93278	93283	93288	93293
57	93298	93303	93308	93313	93318	93323	93328	93334	93339	93344
58	93349	93354	93359	93364	93369	93374	93379	93384	93389	93394
59	93399	93404	93409	93414	93420	93425	93430	93435	93440	93445
860	2.93450	2.93455	2.93460	2.93465	2.93470	2.93475	2.93480	2.93485	2.93490	2.93495
61	93500	93505	93510	93515	93520	93526	93531	93536	93541	93546
62	93551	93556	93561	93566	93571	93576	93581	93586	93591	93596
63	93601	93606	93611	93616	93621	93626	93631	93636	93641	93646
64	93651	93656	93661	93666	93671	93676	93682	93687	93692	93697
65	93702	93707	93712	93717	93722	93727	93732	93737	93742	93747
66	93752	93757	93762	93767	93772	93777	93782	93787	93792	93797
67	93802	93807	93812	93817	93822	93827	93832	93837	93842	93847
68	93852	93857	93862	93867	93872	93877	93882	93887	93892	93897
69	93902	93907	93912	63917	93922	93927	93932	93937	93942	93947
870	2.93952	2.93957	2.93962	2.93967	2.93972	2.93977	2.93982	2.93987	2.93992	2.93997
71	94002	94007	94012	94017	94022	94027	94032	94037	94042	94047
72	94052	94057	94062	94067	94072	94077	94082	94086	94091	94096
73	94101	94106	94111	94116	94121	94126	94131	94136	94141	94146
74	94151	94156	94161	94166	94171	94176	94181	94186	94191	94196
75	94201	94206	94211	94216	94221	94226	94231	94236	94240	94245
76	94250	94255	94260	94265	94270	94275	94280	94285	94290	94295
77	94300	94305	94310	94315	94320	94325	94330	94335	94340	94345
78	94349	94354	94359	94364	94369	94374	94379	94384	94389	94394
79	94399	94404	94409	94414	94419	94424	94429	94433	94438	94443

TABLE IV.

A Table of Logarithms from 1 to 10,000.

	2	3	4	5	6	7	8	9
1	2.44747	2.44762	2.44778	2.44793	2.44809	2.44824	2.44840	2.44855
6	44902	44917	44932	44948	44963	44979	44994	45010
0	45056	45071	45086	45102	45117	45133	45148	45163
4	45209	45225	45240	45255	45271	45286	45301	45317
7	45362	45378	45393	45408	45423	45439	45454	45469
0	45515	45530	45545	45561	45576	45591	45606	45621
2	45667	45682	45697	45712	45728	45743	45758	45773
3	45818	45834	45849	45864	45879	45894	45909	45924
4	45969	45984	46000	46015	46030	46045	46060	46075
05	46120	46135	46150	46165	46180	46195	46210	46225
55	2.46270	2.46285	2.46300	2.46315	2.46330	2.46345	2.46359	2.46374
04	46419	46434	46449	46464	46479	46494	46509	46523
53	46568	46583	46598	46613	46627	46642	46657	46672
02	46716	46731	46746	46761	46776	46790	46805	46820
50	46864	46879	46894	46909	46923	46938	46953	46967
97	47012	47026	47041	47056	47070	47085	47100	47114
44	47159	47173	47188	47202	47217	47232	47246	47261
90	47305	47319	47334	47349	47363	47378	47392	47407
36	47451	47465	47480	47494	47509	47524	47538	47553
82	47596	47611	47625	47640	47654	47669	47683	47698
27	2.47741	2.47756	2.47770	2.47784	2.47799	2.47813	2.47828	2.47842
71	47885	47900	47914	47929	47943	47958	47972	47986
15	48029	48044	48058	48073	48087	48101	48116	48130
59	48173	48187	48202	48216	48230	48244	48259	48273
02	48316	48330	48344	48359	48373	48387	48401	48416
44	48458	48473	48487	48501	48515	48530	48544	48558
86	48601	48615	48629	48643	48657	48671	48686	48700
28	48742	48756	48770	48785	48799	48813	48827	48841
69	48883	48897	48911	48926	48940	48954	48968	48982
10	49024	49038	49052	49066	49080	49094	49108	49122

TABLE IV.

A Table of Logarithms from 1 to 10,000.

N°	0	1	2	3	4	5	6	7	8	9
940	2.97313	2.97317	2.97322	2.97327	2.97331	2.97336	2.97340	2.97345	2.97350	2.97354
41	97359	97364	97368	97373	97377	97382	67387	67391	97396	97400
42	97405	97410	97414	97419	97424	97428	97433	97437	97442	97447
43	97451	97456	97460	97465	97470	97474	97479	97483	97488	97493
44	97497	97502	97506	97511	97516	97520	97525	97529	97534	97539
45	97543	97548	97552	97557	97562	97566	97571	97575	97580	97585
46	97589	97594	97598	97603	97607	97612	97617	97621	97626	97630
47	97635	97640	97644	97649	97653	97658	97663	97667	97672	97676
48	97681	97685	97690	97695	97699	97704	97708	97713	97717	97722
49	97727	97731	97736	97740	97745	97749	97754	97759	97763	97768
950	2.97772	2.97777	2.97782	2.97786	2.97791	2.97795	2.97800	2.97804	2.97809	2.97813
51	97818	97823	97827	97832	97836	97841	97845	97850	97855	97859
52	97864	97868	97873	97877	97882	97886	97891	97896	97900	97905
53	97909	97914	97918	97923	97928	97932	97937	97941	97946	97950
54	97955	97959	97964	97968	97973	97978	97982	97987	97991	97996
55	98000	98005	98009	98014	98019	98023	98028	98032	98037	98041
56	98046	98050	98055	98059	98064	98068	98073	98078	98082	98087
57	98091	98096	98100	98105	98109	98114	98118	98123	98127	98132
58	98137	98141	98146	98150	98155	98159	98164	98168	98173	98177
59	98182	98186	98191	98195	98200	98204	98209	98214	98218	98223
960	2.98227	2.98232	2.98236	2.98241	2.98245	2.98250	2.98254	2.98259	2.98263	2.98268
61	98272	98277	98281	98286	98290	98295	98299	98304	98308	98313
62	98318	98322	98327	98331	98336	98340	98345	98349	98354	98358
63	98363	98367	98372	98376	98381	98385	98390	98394	98399	98403
64	98408	98412	98417	98421	98426	98430	98435	98439	98444	98448
65	98453	98457	98462	98466	98471	98475	98480	98484	98489	98493
66	98498	98502	98507	98511	98516	98520	98525	98529	98534	98538
67	98543	98547	98552	98556	98561	98565	98570	98574	98579	98583
68	98588	98592	98597	98601	98605	98610	98614	98619	98623	98628
69	98632	98637	98641	98646	98650	98655	98659	98664	98668	98673
970	2.98677	2.98682	2.98686	2.98691	2.98695	2.98700	2.98704	2.98709	2.98713	2.98717
71	98722	98726	98731	98735	98740	98744	98749	98753	98758	98762
72	98767	98771	98776	98780	98784	98789	98793	98798	98802	98807
73	98811	98816	98820	98825	98829	98834	98838	98843	98847	98851
74	98856	98860	98865	98869	98874	98878	98883	98887	98892	98896
75	98900	98905	98909	98914	98918	98923	98927	98932	98936	98941
76	98945	98949	98954	98958	98963	98967	98972	98976	98981	98985
77	98989	98994	98998	99003	99007	99012	99016	99021	99025	99029
78	99034	99038	99043	99047	99052	99056	99061	99065	99069	99074
79	99078	99083	99087	99092	99096	99100	99105	99109	99114	99118
980	2.99123	2.99127	2.99131	2.99136	2.99140	2.99145	2.99149	2.99154	2.99158	2.99162
81	99167	99171	99176	99180	99185	99189	99193	99198	99202	99207
82	99211	99216	99220	99224	99229	99233	99238	99242	99247	99251
83	99255	99260	99264	99269	99273	99277	99282	99286	99291	99295
84	99300	99304	99308	99313	99317	99322	99326	99330	99335	99339
85	99344	99348	99352	99357	99361	99366	99370	99374	99379	99383
86	99388	99392	99396	99401	99405	99410	99414	99419	99423	99427
87	99432	99436	99441	99445	99449	99454	99458	99463	99467	99471
88	99476	99480	99484	99489	99493	99498	99502	99506	99511	99515
89	99520	99524	99528	99533	99537	99542	99546	99550	99555	99559
990	2.99564	2.99568	2.99572	2.99577	2.99581	2.99585	2.99590	2.99594	2.99599	2.99603
91	99607	99612	99616	99621	99625	99629	99634	99638	99642	99647
92	99651	99656	99660	99664	99669	99673	99677	99682	99685	99691
93	99695	99699	99704	99708	99712	99717	99721	99726	99730	99734
94	99739	99748	99747	99752	99756	99760	99765	99769	99774	99778
95	99782	99787	99791	99795	99800	99804	99808	99813	99817	99822
96	99826	99830	99835	99839	99848	99848	99852	99856	99861	99865
97	99870	99874	99878	99883	99887	99891	99896	99900	99904	99909
98	99913	99917	99922	99926	99930	99935	99939	99944	99948	99952
99	99957	99961	99965	99970	99974	99978	99983	99987	99991	99996

Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
.00000	00.00000	Infinite.	10.00000	Infinite.	60
00000	6.46373	13.53627	10.00000	13.53627	59
00000	76476	23524	00000	23524	58
00000	94085	05915	00000	05915	57
00000	7.06579	12.93421	00000	12.93421	56
00000	16270	83730	00000	83730	55
00000	24188	75812	00000	75812	54
00000	30882	69118	00000	69118	53
00000	36682	63318	00000	63318	52
00000	41797	58203	00000	58203	51
00000	46373	53627	00000	53627	50
.00000	7.50512	12.49488	10.00000	12.49488	49
00000	54291	45709	00000	45709	48
00000	57767	42233	00000	42233	47
00000	60986	39014	00000	39015	46
00000	63982	36018	00000	36018	45
.99999	66785	33215	00001	33216	44
99999	69418	30582	00001	30583	43
99999	71900	28100	00001	28100	42
99999	74248	25752	00001	25752	41
99999	76476	23524	00001	23525	40
.99999	7.78595	12.21405	10.00001	12.21406	39
99999	80615	19385	00001	19385	38
99999	82546	17454	00001	17455	37
99999	84394	15606	00001	15607	36
99999	86167	13833	00001	13834	35
99999	87871	12129	00001	12130	34
99999	89510	10490	00001	10491	33
99999	91089	08911	00001	08912	32
99999	92613	07387	00001	07388	31
99998	94086	05914	00002	05915	30
.99998	7.95510	12.04490	10.00002	12.04492	29

TABLE V. Of Artificial Sines, Tangents, and Secants. 1 Deg.

M.	Sine.	Co-sine.	Tangent.	Co-tang	Secant.	Co-secant.	
0	8.24186	9.99993	8.24192	11.75808	10.00007	11.75814	60
1	24903	99993	24910	75090	00007	75097	59
2	25609	99993	25616	74384	00007	74391	58
3	26304	99993	26312	73688	00007	73696	57
4	26988	99993	26996	73004	00007	73012	56
5	27661	99992	27669	72331	00008	72339	55
6	28324	99992	28332	71668	00008	71676	54
7	28977	99992	28986	71014	00008	71023	53
8	29621	99992	29629	70371	00008	70379	52
9	30255	99991	30263	69737	00009	69745	51
10	8.30879	9.99991	8.30888	11.69112	10.00009	11.69121	50
11	31495	99991	31505	68495	00009	68505	49
12	32103	99991	32112	67888	00009	67897	48
13	32702	99990	32711	67289	00010	67298	47
14	33292	99990	33302	66698	00010	66708	46
15	33875	99990	33886	66114	00010	66125	45
16	34450	99989	34461	65539	00011	65550	44
17	35018	99989	35029	64971	00011	64982	43
18	35578	99989	35590	64410	00011	64422	42
19	36132	99989	36143	63857	00011	63868	41
20	8.36678	9.99988	8.36689	11.63311	10.00012	11.63322	40
21	37217	99988	37229	62771	00012	62783	39
22	37750	99988	37762	62238	00012	62250	38
23	38276	99987	38289	61711	00013	61724	37
24	38796	99987	38809	61191	00013	61204	36
25	39310	99987	39323	60677	00013	60590	35
26	39818	99986	39832	60168	00014	60182	34
27	40320	99986	40334	59666	00014	59680	33
28	40816	99986	40830	59170	00014	59184	32
29	41307	99985	41321	58679	00015	58693	31
30	8.41792	9.99985	8.41807	11.58193	10.00015	11.58208	30
31	42272	99985	42287	57713	00015	57728	29
32	42746	99984	42762	57238	00016	57254	28
33	43216	99984	43232	56768	00016	56784	27
34	43680	99984	43696	56304	00016	56320	26
35	44139	99983	44156	55844	00017	55861	25
36	44594	99983	44611	55389	00017	55406	24
37	45044	99983	45061	54939	00017	54956	23
38	45489	99982	45507	54493	00018	54510	22
39	45930	99982	45948	54052	00018	54070	21
40	8.46367	9.99982	8.46385	11.53615	10.00018	11.53633	20
41	46799	99981	46817	53183	00019	53201	19
42	47226	99981	47245	52755	00019	52774	18
43	47650	99981	47669	52331	00019	52350	17
44	48069	99980	48089	51911	00020	51931	16
45	48485	99980	48505	51495	00020	51515	15
46	48896	99979	48917	51083	00021	51104	14
47	49304	99979	49325	50675	00021	50696	13
48	49708	99979	49729	50271	00021	50292	12
49	50108	99978	50130	49870	00022	49892	11
50	8.50505	9.99978	8.50527	11.49473	10.00022	11.49495	10
51	50897	99977	50920	49080	00023	49103	9
52	51287	99977	51310	48690	00023	48713	8
53	51673	99977	51696	48304	00023	48327	7
54	52055	99976	52079	47921	00024	47945	6
55	52434	99976	52459	47541	00024	47566	5
56	52810	99975	52835	47165	00025	47190	4
57	53183	99975	53208	46792	00025	46817	3
58	53552	99974	53578	46422	00026	46448	2
59	53919	99974	53945	46055	00026	46081	1
60	54282	99974	54308	45692	00026	45718	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

88 Degrees.

Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
9.99974	8.54308	11.45692	10.00026	11.45718	60
99973	54669	45331	00027	45358	59
99973	55027	44973	00027	45001	58
99972	55382	44618	00028	44646	57
99972	55734	44266	00028	44295	56
99971	56083	43917	00029	43946	55
99971	56429	43571	00029	43600	54
99970	56773	43227	00030	43257	53
99970	57114	42886	00030	42916	52
99969	57452	42548	00031	42579	51
9.99969	8.57788	11.42212	10.00031	11.42243	50
99968	58121	41879	00032	41911	49
99968	58451	41549	00032	41581	48
99968	58779	41221	00032	41253	47
99967	59105	40895	00033	40928	46
99967	59428	40572	00033	40605	45
99966	59749	40251	00034	40285	44
99966	60068	39932	00034	39967	43
99965	60384	39616	00035	39651	42
99965	60698	39302	00035	39338	41
9.99964	8.61009	11.38991	10.00036	11.39027	40
99964	61319	38681	00036	38718	39
99963	61626	38374	00037	38411	38
99962	61931	38069	00038	38106	37
99962	62234	37766	00038	37804	36
99961	62535	37465	00039	37503	35
99961	62834	37166	00039	37205	34
99960	63131	36869	00040	36909	33
99960	63426	36574	00040	36615	32
99959	63718	36282	00041	36322	31
9.99959	8.64009	11.35991	10.00041	11.36032	30
99958	64298	35702	00042	35744	29

TABLE V. Of Artificial Sines, Tangents, and Secants. 3 Degs.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	8.71880	9.99940	8.71940	11.28060	10.00060	11.28120	60
1	72120	99940	72181	27819	00060	27880	59
2	72360	99939	72420	27580	00061	27640	58
3	72597	99938	72659	27341	00062	27403	57
4	72834	99938	72896	27104	00062	27166	56
5	73069	99937	73132	26868	00063	26931	55
6	73303	99936	73366	26634	00064	26697	54
7	73535	99936	73599	26400	00064	26465	53
8	73767	99935	73832	26168	00065	26233	52
9	73997	99934	74063	25937	00066	26003	51
10	8.74226	9.99934	8.74292	11.25708	10.00066	11.25774	50
11	74454	99933	74521	25479	00067	25546	49
12	74680	99932	74748	25252	00068	25320	48
13	74906	99932	74974	25026	00068	25094	47
14	75130	99931	75199	24801	00069	24870	46
15	75353	99930	75423	24577	00070	24647	45
16	75575	99929	75645	24355	00071	24425	44
17	75796	99929	75867	24133	00071	24204	43
18	76015	99928	76087	23913	00072	23985	42
19	76234	99927	76306	23694	00073	23766	41
20	8.76451	9.99927	8.76525	11.23475	10.00073	11.23549	40
21	76667	99926	76742	23258	00074	23332	39
22	76883	99925	76958	23042	00075	23117	38
23	77097	99924	77173	22827	00076	22903	37
24	77310	99924	77387	22613	00076	22690	36
25	77522	99923	77600	22400	00077	22478	35
26	77733	99922	77811	22189	00978	22267	34
27	77943	99921	78022	21978	00079	22057	33
28	78152	99921	78232	21768	00079	21848	32
29	78361	99920	78441	21559	00080	21639	31
30	8.78568	9.99919	8.78649	11.21351	10.00081	11.21432	30
31	78774	99918	78855	21145	00082	21226	29
32	78979	99917	79061	20939	00083	21021	28
33	79183	99917	79266	20734	00083	20817	27
34	79386	99916	79470	20530	00084	20614	26
35	79588	99915	79673	20327	00085	20412	25
36	79789	99914	79875	20125	00086	20211	24
37	79990	99913	80076	19924	00087	20010	23
38	80189	99913	80277	19723	00087	19811	22
39	80388	99912	80476	19524	00088	19612	21
40	8.80585	9.99911	8.80674	11.19326	10.00089	11.19415	20
41	80782	99910	80872	19128	00090	19218	19
42	80978	99909	81068	18932	00091	19022	18
43	81173	99909	81264	18736	00091	18827	17
44	81367	99908	81459	18541	00092	18633	16
45	81560	99907	81653	18347	00093	18440	15
46	81752	99906	81846	18154	00094	18248	14
47	81944	99905	82038	17962	00095	18056	13
48	82134	99904	82230	17770	00096	17866	12
49	82324	99904	82420	17580	00096	17676	11
50	8.82513	9.99903	8.82610	11.17390	10.00097	11.17487	10
51	82701	99902	82799	17201	00098	17299	9
52	82888	99901	82987	17013	00099	17112	8
53	83073	99900	83175	16825	00100	16925	7
54	83261	99899	83361	16639	00101	16739	6
55	83446	99898	93547	16453	00102	16554	5
56	83630	99898	83732	16268	00102	16370	4
57	83813	99897	83916	16084	00103	16187	3
58	83996	99896	84100	15900	00104	16004	2
59	84177	99895	84282	15718	00105	15823	1
60	84358	99894	84464	15536	00106	15642	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
.99894	8.84464	11.15536	10.00106	11.15642	60
99893	84646	15354	00107	15461	59
99892	84826	15174	00108	15282	58
99891	85006	14994	00109	15103	57
99891	85185	14815	00109	14925	56
99890	85363	14637	00110	14748	55
99889	85540	14460	00111	14571	54
99888	85717	14283	00112	14395	53
99887	85893	14107	00113	14220	52
99886	86069	13931	00114	14045	51
.99885	8.86243	11.13757	10.00115	11.13872	50
99884	86417	13583	00116	13699	49
99883	86591	13409	00117	13526	48
99882	86763	13237	00118	13355	47
99881	86935	13065	00119	13184	46
99880	87106	12894	00120	13013	45
99879	87277	12723	00121	12844	44
99879	87447	12553	00121	12675	43
99878	87616	12384	00122	12506	42
99877	87785	12215	00123	12339	41
.99876	8.87953	11.12047	10.00124	11.12171	40
99875	88120	11880	00125	12005	39
99874	88287	11713	00126	11839	38
99873	88453	11547	00127	11674	37
99872	88618	11382	00128	11510	36
99871	88783	11217	00129	11346	35
99870	88948	11052	00130	11183	34
99869	89111	10889	00131	11020	33
99868	89274	10726	00132	10858	32
99867	89437	10563	00133	10696	31
.99866	8.89598	11.10402	10.00134	11.10536	30

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	8.94030	9.99834	8.94195	11.05805	10.00166	11.05970	60
1	94174	99833	94340	05660	00167	05826	59
2	94317	99832	94485	05515	00168	05683	58
3	94461	99831	94630	05370	00169	05539	57
4	94603	99830	94773	05227	00170	05397	56
5	94746	99829	94917	05083	00171	05254	55
6	94887	99828	95060	04940	00172	05113	54
7	95029	99827	95202	04798	00173	04971	53
8	95170	99825	95344	04656	00175	04830	52
9	95310	99824	95486	04514	00176	04690	51
10	8.95450	9.99823	8.95627	11.04373	10.00177	11.04550	50
11	95589	99822	95767	04233	00178	04411	49
12	95728	99821	95908	04092	00179	04272	48
13	95867	99820	96047	03953	00180	04133	47
14	96005	99819	96187	03813	00181	03995	46
15	96143	99817	96325	03675	00183	03857	45
16	96280	99816	96464	03536	00184	03720	44
17	96417	99815	96602	03398	00185	03583	43
18	96553	99814	96739	03261	00186	03447	42
19	96689	99813	96877	03123	00187	03311	41
20	8.96825	9.99812	8.97013	11.02987	10.00188	11.03175	40
21	96960	99810	97150	02850	00190	03040	39
22	97095	99809	97285	02715	00191	02905	38
23	97229	99808	97421	02579	00192	02771	37
24	97363	99807	97556	02444	00193	02637	36
25	97496	99806	97691	02309	00194	02504	35
26	97629	99804	97825	02175	00196	02371	34
27	97762	99803	97959	02041	00197	02238	33
28	97894	99802	98092	01908	00198	02106	32
29	98026	99801	98225	01775	00199	01974	31
30	8.98157	9.99800	8.98358	11.01645	10.00200	11.01843	30
31	98288	99798	98490	01510	00202	01712	29
32	98419	99797	98622	01378	00203	01581	28
33	98549	99796	98753	01247	00204	01451	27
34	98679	99795	98884	01116	00205	01321	26
35	98808	99793	99015	00985	00207	01192	25
36	98937	99792	99145	00855	00208	01063	24
37	99066	99791	99275	00725	00209	00934	23
38	99194	99790	99405	00595	00210	00806	22
39	99322	99788	99534	00466	00212	00678	21
40	8.99450	9.99787	8.99662	11.00338	10.00213	11.00550	20
41	99577	99786	99791	00209	00214	00423	19
42	99704	99785	99919	00081	00215	00296	18
43	99830	99783	9.00046	10.99954	00217	00170	17
44	99956	99782	00174	99826	00218	00044	16
45	9.00082	99781	00301	99699	00219	10.99918	15
46	00207	99780	00427	99573	00220	99793	14
47	00332	99778	00553	99447	00222	99668	13
48	00456	99777	00679	99321	00223	99544	12
49	00581	99776	00805	99195	00224	99419	11
50	9.00704	9.99775	9.00930	10.99070	10.00225	10.99296	10
51	00828	99773	01055	98945	00227	99172	9
52	00951	99772	01179	98821	00228	99049	8
53	01074	99771	01303	98697	00229	98926	7
54	01196	99769	01427	98573	00231	98804	6
55	01318	99768	01550	98450	00232	98682	5
56	01440	99767	01673	98327	00233	98560	4
57	01561	99765	01796	98204	00235	98439	3
58	01682	99764	01918	98082	00236	98318	2
59	01803	99763	02040	97960	00237	98197	1
60	01923	99761	02162	97838	00239	98077	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
9.99761	9.02162	10.97838	10.00239	10.98077	60
99760	02283	97717	00240	97957	59
99759	02404	97596	00241	97837	58
99757	02525	97475	00243	97717	57
99756	02645	97355	00244	97598	56
99755	02766	97234	00245	97480	55
99753	02885	97115	00247	97361	54
99752	03005	96995	00248	97243	53
99751	03124	96876	00249	97126	52
99749	03242	96758	00251	97008	51
9.99748	9.03361	10.96639	10.00252	10.96891	50
99747	03479	96521	00253	96774	49
99745	03597	96403	00255	96658	48
89744	03714	96286	00256	96542	47
99742	03832	96168	00258	96426	46
99741	03948	96052	00259	96310	45
99740	04065	95935	00260	96195	44
99738	04181	95819	00262	96080	43
99737	04297	95703	00263	95966	42
99736	04413	95587	00264	95851	41
9.99734	9.04528	10.95472	10.00266	10.95738	40
99733	04643	95357	00267	95624	39
99731	04758	95242	00269	95510	38
99730	04873	95127	00270	95397	37
99728	04987	95013	00272	95285	36
99727	05101	94899	00273	95172	35
99726	05214	94786	00274	95060	34
99724	05328	94672	00276	94948	33
99723	05441	94559	00277	94836	32
99721	05553	94447	00279	94725	31
9.99720	9.05666	10.94334	10.00280	10.94614	30
99718	05778	94222	00282	94503	29

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.08589	9.99675	9.08914	10.91086	10.00325	10.91411	60
1	08692	99674	09019	90981	00326	91308	59
2	08795	69672	09123	90877	00328	91205	58
3	08897	99670	09227	90773	00330	91103	57
4	08999	99669	09330	90670	00331	91001	56
5	09101	99667	09434	90566	00333	90899	55
6	09202	99666	09537	90463	00334	90798	54
7	09304	99664	09640	90360	00336	90696	53
8	09405	99662	09742	90258	00337	90595	52
9	09506	99661	09845	90155	00339	90494	51
10	9.09606	9.99659	9.09947	10.90053	10.00341	10.90394	50
11	09707	99658	10049	89951	00342	90293	49
12	09807	99656	10150	89850	00344	90193	48
13	09907	99655	10252	89748	00345	90093	47
14	10006	99653	10353	89647	00347	89994	46
15	10106	99651	10454	89546	00349	89894	45
16	10205	99650	10555	89445	00350	89795	44
17	10304	99648	10656	89344	00352	89696	43
18	10402	99647	10756	89244	00353	89598	42
19	10501	99645	10856	89144	00355	89499	41
20	9.10599	9.99643	9.10956	10.89044	10.00357	10.89401	40
21	10697	99642	11056	88944	00358	89303	39
22	10795	99640	11155	88845	00360	89205	38
23	10893	99638	11254	88746	00362	89107	37
24	10990	99637	11353	88647	00363	89010	36
25	11087	99635	11452	88548	00365	88913	35
26	11184	99633	11551	88449	00367	88816	34
27	11281	99632	11649	88351	00368	88719	33
28	11377	99630	11747	88253	00370	88623	32
29	11474	99629	11845	88155	00371	88526	31
30	9.11570	9.99627	9.11943	10.88057	10.00373	10.88430	30
31	11666	99625	12040	87960	00375	88334	29
32	11761	99624	12138	87862	00376	88239	28
33	11857	99622	12235	87765	00378	88143	27
34	11952	99620	12332	87668	00380	88048	26
35	12047	99618	12428	87572	00382	87953	25
36	12142	99617	12525	87475	00383	87858	24
37	12236	99615	12621	87379	00385	87764	23
38	12331	99613	12717	87283	00387	87669	22
39	12425	99612	12813	87187	00388	87575	21
40	9.12519	9.99610	9.12909	10.87091	10.00390	10.87481	20
41	12612	99608	13004	86996	00392	87388	19
42	12706	99607	13099	86901	00393	87294	18
43	12799	99605	13194	86806	00395	87201	17
44	12892	99603	13289	86711	00397	87108	16
45	12985	99601	13384	86616	00399	87015	15
46	13078	99600	13478	86522	00400	86922	14
47	13171	99598	13573	86427	00402	86829	13
48	13263	99596	13667	86333	00404	86737	12
49	13355	99595	13761	86239	00405	86645	11
50	9.13447	9.99593	9.13854	10.86146	10.00407	10.86553	10
51	13539	99591	13948	86052	00409	86461	9
52	13630	99589	14041	85959	00411	86370	8
53	13722	99588	14134	85866	00412	86278	7
54	13813	99586	14227	85773	00414	86187	6
55	13904	99584	14320	85680	00416	86096	5
56	13994	99582	14412	85588	00418	86006	4
57	14085	99581	14504	85496	00419	85915	3
58	14175	99579	14597	85403	00421	85825	2
59	14266	99577	14688	85312	00423	85734	1
60	14356	99575	14780	85220	00425	85644	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
9.99575	9.14780	10.85220	10.00425	10.85644	60
99574	14872	85128	00426	85555	59
99572	14963	85037	00428	85465	58
99570	15054	84946	00430	85376	57
99568	15145	84855	00432	85286	56
99566	15236	84764	00434	85197	55
99565	15327	84673	00435	85109	54
99563	15417	84583	00437	85020	53
99561	15508	84492	00439	84931	52
99559	15598	84402	00441	84843	51
9.99557	9.15688	10.84312	10.00443	10.84755	50
99556	15777	84223	00444	84667	49
99554	15867	84133	00446	84579	48
99552	15956	84044	00448	84492	47
99550	16046	83954	00450	84404	46
99548	16135	83865	00452	84317	45
99546	16224	83776	00454	84230	44
98545	16312	83688	00455	84143	43
99543	16401	83599	00457	84056	42
99541	16489	83511	00459	83970	41
9.99539	9.16577	10.83423	10.00461	10.83884	40
99537	16665	83335	00463	83797	39
99535	16753	83247	00465	83711	38
99533	16841	83159	00467	83626	37
99532	16928	83072	00468	83540	36
99530	17016	82984	00470	83455	35
99528	17103	82897	00472	83369	34
99526	17190	82810	00474	83284	33
99524	17277	82723	00476	83199	32
99522	17363	82637	00478	83114	31
9.99520	9.17450	10.82550	10.00480	10.83030	30
99518	17536	82464	00482	82945	29

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.19433	9.99462	9.19971	10.80029	10.00538	10.80567	60
1	19513	99460	20053	79947	00540	80487	59
2	19592	99458	20134	79866	00542	80408	58
3	19672	99456	20216	79784	00544	80328	57
4	19751	99454	20297	79703	00546	80249	56
5	19830	99452	20378	79622	00548	80170	55
6	19909	99450	20459	79541	00550	80091	54
7	19988	99448	20540	79460	00552	80012	53
8	20067	99446	20621	79379	00554	79933	52
9	20145	99444	20701	79299	00556	79855	51
10	9.20223	9.99442	9.20782	10.79218	10.00558	10.79777	50
11	20302	99440	20862	79138	00560	79698	49
12	20380	99438	20942	79058	00562	79620	48
13	20458	99436	21022	78978	00564	79542	47
14	20535	99434	21102	78898	00566	79465	46
15	20613	99432	21182	78818	00568	79387	45
16	20691	99429	21261	78739	00571	79309	44
17	20768	99427	21341	78659	00573	79232	43
18	20845	99425	21420	78580	00575	79155	42
19	20922	99423	21499	78501	00577	79078	41
20	9.20999	9.99421	9.21578	10.78422	10.00579	10.79001	40
21	21076	99419	21657	78343	00581	78924	39
22	21153	99417	21736	78264	00583	78847	38
23	21229	99415	21814	78186	00585	78771	37
24	21306	99413	21893	78107	00587	78694	36
25	21382	99411	21971	78029	00589	78618	35
26	21458	99409	22049	77951	00591	78542	34
27	21534	99407	22127	77873	00593	78466	33
28	21610	99404	22205	77795	00596	78390	32
29	21685	99402	22283	77717	00598	78315	31
30	9.21761	9.99400	9.22361	10.77639	10.00600	10.78239	30
31	21836	99398	22438	77562	00602	78164	29
32	21912	99396	22516	77484	00604	78088	28
33	21987	99394	22593	77407	00606	78013	27
34	22062	99392	22670	77330	00608	77938	26
35	22137	99390	22747	77253	00610	77863	25
36	22211	99388	22824	77176	00612	77789	24
37	22286	99385	22901	77099	00615	77714	23
38	22361	99383	22977	77023	00617	77639	22
39	22435	99381	23054	76946	00619	77565	21
40	9.22509	9.99379	9.23130	10.76870	10.00621	10.77491	20
41	22583	99377	23206	76794	00623	77417	19
42	22657	99375	23283	76717	00625	77343	18
43	22731	99372	23359	76641	00628	77269	17
44	22805	99370	23435	76565	00630	77195	16
45	22878	99368	23510	76490	00632	77122	15
46	22952	99366	23586	76414	00634	77048	14
47	23025	99364	23661	76339	00636	76975	13
48	23098	99362	23737	76263	00638	76902	12
49	23171	99359	23812	76188	00641	76829	11
50	9.23244	9.99357	9.23887	10.76113	10.00643	10.76756	10
51	23317	99355	23962	76038	00645	76683	9
52	23390	99353	24037	75963	00647	76610	8
53	23462	99351	24112	75888	00649	76538	7
54	23535	99348	24186	75814	00652	76465	6
55	23607	99346	24261	75739	00654	76393	5
56	23679	99344	24335	75665	00656	76321	4
57	23752	99342	24410	75590	00658	76248	3
58	23823	99340	24484	75516	00660	76177	2
59	23895	99337	24558	75442	00663	76105	1
60	23967	99335	24632	75368	00665	76033	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
.99335	9.24632	10.75368	10.00665	10.76033	60
99333	24706	75294	00667	75961	59
99331	24779	75221	00669	75890	58
99328	24853	75147	00672	75819	57
99326	24926	75074	00674	75747	56
99324	25000	75000	00676	75676	55
99322	25073	74927	00678	75605	54
99319	25146	74854	00681	75534	53
99317	25219	74781	00683	75464	52
99315	25292	74708	00685	75393	51
.99313	9.25365	10.74635	10.00687	10.75323	50
99310	25437	74563	00690	75252	49
99308	25510	74490	00692	75182	48
99306	25582	74418	00694	75112	47
99304	25655	74345	00696	75042	46
99301	25727	74273	00699	74972	45
96299	25799	74201	00701	74902	44
99297	25871	74129	00703	74832	43
99294	25943	74057	00706	74763	42
99292	26016	73985	00708	74693	41
.99290	9.26086	10.73914	10.00710	10.74624	40
99288	26158	73842	00712	74555	39
99285	26229	73771	00715	74486	38
99283	26301	73699	00717	74417	37
99281	26372	73628	00719	74348	36
99278	26443	73557	00722	74279	35
99276	26514	73486	00724	74210	34
99274	26585	73415	00726	74142	33
99271	26655	73345	00729	74073	32
99269	26726	73274	00731	74005	31
.99267	9.26797	10.73203	10.00733	10.73937	30
99264	26867	73133	00736	73869	29

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.28060	9.99195	9.28865	10.71135	10.00805	10.71940	60
1	28125	99192	28933	71067	00808	71875	59
2	28190	99190	29000	71000	00810	71810	58
3	28254	99187	29067	70933	00813	71746	57
4	28319	99185	29134	70866	00815	71681	56
5	28384	99182	29201	70799	00818	71616	55
6	28448	99180	29268	70732	00820	71552	54
7	28512	99177	29335	70665	00823	71488	53
8	28577	99175	29402	70598	00825	71423	52
9	28641	99172	29468	70532	00828	71359	51
10	9.28705	9.99170	9.29535	10.70465	10.00830	10.71295	50
11	28769	99167	29601	70399	00833	71231	49
12	28833	99165	29668	70332	00835	71167	48
13	28896	99162	29734	70266	00838	71104	47
14	28960	99160	29800	70200	00840	71040	46
15	29024	99157	29866	70134	00843	70976	45
16	29087	99155	29932	70068	00845	70913	44
17	29150	99152	29998	70002	00848	70850	43
18	29214	99150	30064	69936	00850	70786	42
19	29277	99147	30130	69870	00853	70723	41
20	9.29340	9.99145	9.30195	10.69805	10.00855	10.70660	40
21	29403	99142	30261	69739	00858	70597	39
22	29466	99140	30326	69674	00860	70534	38
23	29529	99137	30391	69609	00863	70471	37
24	29591	99135	30457	69543	00865	70409	36
25	29654	99132	30522	69478	00868	70346	35
26	29716	99130	30587	69413	00870	70284	34
27	29779	99127	30652	69348	00873	70221	33
28	29841	99124	30717	69283	00876	70159	32
29	29903	99122	30782	69218	00878	70097	31
30	9.29966	9.99119	9.30846	10.69154	10.00881	10.70034	30
31	30028	99117	30911	69089	00883	69972	29
32	30090	99114	30975	69025	00886	69910	28
33	30151	99112	31040	68960	00888	69849	27
34	30213	99109	31104	68896	00891	69787	26
35	30275	99106	31168	68832	00894	69725	25
36	30336	99104	31233	68767	00896	69664	24
37	30398	99101	31297	68703	00899	69602	23
38	30459	99099	31361	68639	00901	69541	22
39	30521	99096	31425	68575	00904	69479	21
40	9.30582	9.99093	9.31489	10.68511	10.00907	10.69418	20
41	30643	99091	31552	68448	00909	69357	19
42	30704	99088	31616	68384	00912	69296	18
43	30765	99086	31679	68321	00914	69235	17
44	30826	99083	31743	68257	00917	69174	16
45	30887	99080	31806	68194	00920	69113	15
46	30947	99078	31870	68130	00922	69053	14
47	31008	99075	31933	68067	00925	68992	13
48	31068	99072	31996	68004	00928	68932	12
49	31129	99070	32059	67941	00930	68871	11
50	9.31189	9.99067	9.32122	10.67878	10.00933	10.68811	10
51	31250	99064	32185	67815	00936	68750	9
52	31310	99062	32248	67752	00938	68690	8
53	31370	99059	32311	67689	00941	68630	7
54	31430	99056	32373	67627	00944	68570	6
55	31490	99054	32436	67564	00946	68510	5
56	31549	99051	32498	67502	00949	68451	4
57	31609	99048	32561	67439	00952	68391	3
58	31669	99046	32623	67377	00954	68331	2
59	31728	99043	32685	67315	00957	68272	1
60	31788	99040	32747	67253	00960	68212	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	
9.99040	9.32747	10.67253	10.00960	10.68212	60
99038	32810	67190	00962	68153	59
99035	32872	67128	00965	68093	58
99032	32933	67067	00968	68034	57
99030	32995	67005	00970	67975	56
99027	33057	66943	00973	67916	55
99024	33119	66881	00976	67857	54
99022	33180	66820	00978	67798	53
99019	33242	66758	00981	67739	52
99016	33303	66697	00984	67681	51
9.99013	9.33365	10.66635	10.00987	10.67622	50
99011	33426	66574	00989	67593	49
99008	33487	66513	00992	67505	48
99005	33548	66452	00995	67447	47
99002	33609	66391	00998	67388	46
99000	33670	66330	01000	67330	45
98997	33731	66269	01003	67272	44
98994	33792	66208	01006	67214	43
98991	33853	66147	01009	67156	42
98989	33913	66087	01011	67098	41
9.98986	3.33974	10.66026	10.01014	10.67040	40
98983	34034	65966	01017	66982	39
98980	34095	65905	01020	66925	38
98978	34155	65845	01022	66867	37
98975	34215	65785	01025	66810	36
98972	34276	65724	01028	66752	35
98969	34336	65664	01031	66695	34
98967	34396	65604	01033	66638	33
98964	34456	65544	01036	66580	32
98961	34516	65484	01039	66523	31
9.98958	9.34576	10.65424	10.01042	10.66466	30
98955	34635	65365	01045	66409	29
98953	34695	65305	01047	66353	28

M	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.35209	9.98872	9.36336	10.63664	10.01128	10.64791	60
1	35263	98869	36394	63606	01131	64737	59
2	35318	98867	36452	63548	01133	64682	58
3	35373	98864	36509	63491	01136	64627	57
4	35427	98861	36566	63434	01139	64573	56
5	35481	98858	36624	63376	01142	64519	55
6	35536	98855	36681	63319	01145	64464	54
7	35590	98852	36738	63262	01148	64410	53
8	35644	98849	36795	63205	01151	64356	52
9	35698	98846	36852	63148	01154	64302	51
10	9.35752	9.98843	9.36909	10.63091	10.01157	10.64248	50
11	35806	98840	36966	63034	01160	64194	49
12	35860	98837	37023	62977	01163	64140	48
13	35914	98834	37080	62920	01166	64086	47
14	35968	98831	37137	62863	01169	64032	46
15	36022	98828	37193	62807	01172	63978	45
16	36075	98825	37250	62750	01175	63925	44
17	36129	98822	37306	62694	01178	63871	43
18	36182	98819	37363	62637	01181	63818	42
19	36236	98816	37419	62581	01184	63764	41
20	9.36289	9.98813	9.37476	10.62524	10.01187	10.63711	40
21	36342	98810	37532	62468	01190	63658	39
22	36395	98807	37588	62412	01193	63605	38
23	36449	98804	37644	62356	01196	63551	37
24	36502	98801	37700	62300	01199	63498	36
25	36555	98798	37756	62244	01202	63445	35
26	36608	98795	37812	62188	01205	63392	34
27	36660	98792	37868	62132	01208	63340	33
28	36713	98789	37924	62076	01211	63287	32
29	36766	98786	37980	62020	01214	63234	31
30	9.36819	9.98783	9.38035	10.61965	10.01217	10.63181	30
31	36871	98780	38091	61909	01220	63129	29
32	36924	98777	38147	61853	01223	63076	28
33	36976	98774	38202	61798	01226	63024	27
34	37028	98771	38257	61743	01229	62972	26
35	37081	98768	38313	61687	01232	62919	25
36	37133	98765	38368	61632	01235	62867	24
37	37185	98762	38423	61577	01238	62815	23
38	37237	98759	38479	61521	01241	62763	22
39	37289	98756	38534	61466	01244	62711	21
40	9.37341	9.98753	9.38589	10.61411	10.01247	10.62659	20
41	37393	98750	38644	61356	01250	62607	19
42	37445	98746	38699	61301	01254	62555	18
43	37497	98743	38754	61246	01257	62503	17
44	37549	98740	38808	61192	01260	62451	16
45	37600	98737	38863	61137	01263	62400	15
46	37652	98734	38918	61082	01266	62348	14
47	37703	98731	38972	61028	01269	62297	13
48	37755	98728	39027	60973	01272	62245	12
49	37806	98725	39082	60918	01275	62194	11
50	9.37858	9.98722	9.39136	10.60864	10.01278	10.62142	10
51	37909	98719	39190	60810	01281	62091	9
52	37960	98715	39245	60755	01285	62040	8
53	38011	98712	39299	60701	01288	61989	7
54	38062	98709	39353	60647	01291	61938	6
55	38113	98706	39407	60593	01294	61887	5
56	38164	98703	39461	60539	01297	61836	4
57	38215	98700	39515	60485	01300	61785	3
58	38266	98697	39569	60431	01303	61734	2
59	38317	98694	39623	60377	01306	61683	1
60	38368	98690	39677	60323	01310	61632	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
9.98690	9.39677	10.60323	10.01310	10.61632	60
98687	39731	60269	01313	61582	59
98684	39785	60215	01316	61531	58
98681	39838	60162	01319	61481	57
98678	39892	60108	01322	61430	56
98675	39945	60055	01325	61380	55
98671	39999	60001	01329	61330	54
98668	40052	59948	01332	61279	53
98665	40106	59894	01335	61229	52
98662	40159	59841	01338	61179	51
9.98659	9.40212	10.59788	10.01341	10.61129	50
98656	40266	59734	01344	61079	49
98652	40319	59681	01348	61029	48
98649	40372	59628	01351	60979	47
98646	40425	59575	01354	60929	46
98643	40478	59522	01357	60879	45
98640	40531	59469	01360	60830	44
98636	40584	59416	01364	60780	43
98633	40636	59364	01367	60730	42
98630	40689	59311	01370	60681	41
9.98627	9.40742	10.59258	10.01373	10.60631	40
98623	40795	59205	01377	60582	39
98620	40847	59153	01380	60533	38
98617	40900	59100	01383	60483	37
98614	40952	59048	01386	60434	36
98610	41005	58995	01390	60385	35
98607	41057	58943	01393	60336	34
98604	41109	58891	01396	60287	33
98601	41161	58839	01399	60238	32
98597	41214	58786	01403	60189	31
9.98594	9.41226	10.58734	10.01406	10.60140	30
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

M	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.41300	9.98494	9.42805	10.57195	10.01506	10.58700	60
1	41347	98491	42856	57144	01509	58653	59
2	41394	98488	42906	57094	01512	58606	58
3	41441	98484	42957	57043	01516	58559	57
4	41488	98481	43007	56993	01519	58512	56
5	41535	98477	43057	56943	01523	58465	55
6	41582	98474	43108	56892	01526	58418	54
7	41628	98471	43158	56842	01529	58372	53
8	41675	98467	43208	56792	01533	58325	52
9	41722	98464	43258	56742	01536	58278	51
10	9.41768	9.98460	9.43308	10.56692	10.01540	10.58232	50
11	41815	98457	43358	56642	01543	58185	49
12	41861	98453	43408	56592	01547	58139	48
13	41908	98450	43458	56542	01550	58092	47
14	41954	98447	43508	56492	01553	58046	46
15	42001	98443	43558	56442	01557	57999	45
16	42047	98440	43607	56393	01560	57953	44
17	42093	98436	43657	56343	01564	57907	43
18	42140	98433	43707	56293	01567	57860	42
19	42186	98429	43756	56244	01571	57814	41
20	9.42232	9.98426	9.43806	10.56194	10.01574	10.57768	40
21	42278	98422	43855	56145	01578	57722	39
22	42324	98419	43905	56095	01581	57676	38
23	42370	98415	43954	56046	01585	57630	37
24	42416	98412	44004	55996	01588	57584	36
25	42461	98409	44053	55947	01591	57539	35
26	42507	98405	44102	55898	01595	57493	34
27	42553	98402	44151	55849	01598	57447	33
28	42599	98398	44201	55799	01602	57401	32
29	42644	98395	44250	55750	01605	57356	31
30	9.42690	9.98391	9.44299	10.55701	10.01609	10.57310	30
31	42735	98388	44348	55652	01612	57265	29
32	42781	98384	44397	55603	01616	57219	28
33	42826	98381	44446	55554	01619	57174	27
34	42872	98377	44495	55505	01623	57128	26
35	42917	98373	44544	55456	01627	57083	25
36	42962	68370	44592	55408	01630	57038	24
37	43008	98366	44641	55359	01634	56992	23
38	43053	98363	44690	55310	01637	56947	22
39	43098	98359	44738	55262	01641	56902	21
40	9.43143	9.98356	9.44787	10.55213	10.01644	10.56857	20
41	43188	98352	44836	55164	01648	56812	19
42	43233	98349	44884	55116	01651	56767	18
43	43278	98345	44933	55067	01655	56722	17
44	43323	98342	44981	55019	01658	56677	16
45	43367	98338	45029	54971	01662	56633	15
46	43412	98334	45078	54922	01666	56588	14
47	43457	98331	45126	54874	01669	56543	13
48	43502	98327	45174	54826	01673	56498	12
49	43546	98324	45222	54778	01676	56454	11
50	9.43591	9.98320	9.45271	10.54729	10.01680	10.56409	10
51	43635	98317	45319	54681	01683	56365	9
52	43680	98313	45367	54633	01687	56320	8
53	43724	98309	45415	54585	01691	56276	7
54	43769	98306	45463	54537	01694	56231	6
55	43813	98302	45511	54489	01698	56187	5
56	43857	98299	45559	54441	01701	56143	4
57	43901	98295	45606	54394	01705	56099	3
58	43946	98291	45654	54346	01709	56054	2
59	43990	98288	45702	54298	01712	56010	1
60	44034	98284	45750	54250	01716	55966	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M

Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
9.98284	9.45750	10.54250	10.01716	10.55966	60
98281	45797	54203	01719	55922	59
98277	45845	54155	01723	55878	58
98273	45892	54108	01727	55834	57
98270	45940	54060	01730	55790	56
98266	45987	54013	01734	55747	55
98262	46035	53965	01738	55703	54
98259	46082	53918	01741	55659	53
98255	46130	53870	01745	55615	52
98251	46177	53823	01749	55572	51
9.98248	9.46224	10.53776	10.01752	10.55528	50
98244	46271	53729	01756	55484	49
98240	46319	53681	01760	55441	48
98237	46366	53634	01763	55398	47
98233	46413	53587	01767	55354	46
98229	46460	53540	01771	55311	45
98226	46507	53493	01774	55267	44
98222	46554	53446	01778	55224	43
98218	46601	53399	01782	55181	42
98215	46648	53352	01785	55138	41
9.98211	9.46694	10.53306	10.01789	10.55095	40
98207	46741	53259	01793	55052	39
98204	46788	53212	01796	55008	38
98200	46835	53165	01800	54965	37
98196	46881	53119	01804	54923	36
98192	46928	53072	01808	54880	35
98189	46975	53025	01811	54837	34
98185	47021	52979	01815	54794	33
98181	47068	52932	01819	54751	32
98177	47114	52886	01823	54708	31
9.98174	9.47160	10.52840	10.01826	10.54666	30

TABLE V. Of Artificial Sines, Tangents, and Secants. 17 Degs.

M.	Sine.	Co-sine.	Tangent.	Cotang.	Secant.	Co-secant.	
0	9.46594	9.98060	9.48534	10.51466	10.01940	10.53406	60
1	46635	98056	48579	51421	01944	53365	59
2	46676	98052	48624	51376	01948	53324	58
3	46717	98048	48669	51331	01952	53283	57
4	46758	98044	48714	51286	01956	53242	56
5	46800	98040	48759	51241	01960	53200	55
6	46841	98036	48804	51196	01964	53159	54
7	46882	98032	48849	51151	01968	53118	53
8	46923	98029	48894	51106	01971	53077	52
9	46964	98025	48939	51061	01975	53036	51
10	9.47005	9.98021	9.48984	10.51016	10.01979	10.52995	50
11	47045	98017	49029	50971	01983	52955	49
12	47086	98013	49073	50927	01987	52914	48
13	47127	98009	49118	50882	01991	52873	47
14	47168	98005	49163	50837	01995	52832	46
15	47209	98001	49207	50793	01999	52791	45
16	47249	97997	49252	50748	02003	52751	44
17	47290	97993	49296	50704	02007	52710	43
18	47330	97989	49341	50659	02011	52670	42
19	47371	97986	49385	50615	02014	52629	41
20	9.47411	9.97982	9.49430	10.50570	10.02018	10.52589	40
21	47452	97978	49474	50526	02022	52548	39
22	47492	97974	49519	50481	02026	52508	38
23	47533	97970	49563	50437	02030	52467	37
24	47573	97966	49607	50393	02034	52427	36
25	47613	97962	49652	50348	02038	52387	35
26	47654	97958	49696	50304	02042	52346	34
27	47694	97954	49740	50260	02046	52306	33
28	47734	97950	49784	50216	02050	52266	32
29	47774	97946	49828	50172	02054	52226	31
30	47814	9.97942	4.49872	10.50128	10.02058	10.52186	30
31	47854	97938	49916	50084	02062	52146	29
32	47894	97934	49960	50040	02066	52106	28
33	47934	97930	50004	49996	02070	52066	27
34	47974	97926	50048	49952	02074	52026	26
35	48014	97922	50092	49908	02078	51986	25
36	48054	97918	50136	49864	02082	51946	24
37	48094	97914	50180	49820	02086	51906	23
38	48133	97910	50223	49777	02090	51867	22
39	48173	97906	50267	49733	02094	51827	21
40	9.48213	9.97902	9.50311	10.49689	10.02098	10.51787	20
41	48252	97898	50355	49645	02102	51748	19
42	48292	97894	50398	49602	02106	51708	18
43	48332	97890	50442	49558	02110	51668	17
44	48371	97886	50485	49515	02114	51629	16
45	48411	97882	50529	49471	02118	51589	15
46	48450	97878	50572	49428	02122	51550	14
47	48490	97874	50616	49384	02126	51510	13
48	48529	97870	50659	49341	02130	51471	12
49	48568	97866	50703	49297	02134	51432	11
50	9.48607	9.97861	9.50746	10.49254	10.02139	10.51393	10
51	48647	97857	50789	49211	02143	51353	9
52	48686	97853	50833	49167	02147	51314	8
53	48725	97849	50876	49124	02151	51275	7
54	48764	97845	50919	49081	02155	51236	6
55	48803	97841	50962	49038	02159	51197	5
56	48842	97837	51005	48995	02163	51158	4
57	48881	97833	51048	48952	02167	51119	3
58	48920	97829	51092	48908	02171	51080	2
59	48959	97825	51135	48865	02175	51041	1
60	48998	97821	51178	48822	02179	51002	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

72 Degrees.

11	49424	[illegible]	[illegible]		
12	49462	97771	51691	48309	02229
13	49500	97767	51734	48266	02233
14	49539	97763	51776	48224	02237
15	49577	97759	51819	48181	02241
16	49615	97754	51861	48139	02246
17	49654	97750	51903	48097	02250
18	49692	97746	51946	48054	02254
19	49730	97742	51988	48012	02258
20	9.49768	9.97738	9.52031	10.47969	10.02262
21	49806	97734	52073	47927	02266
22	49844	97729	52115	47885	02271
23	49882	97725	52157	47843	02275
24	49920	97721	52200	47800	02279
25	49958	97717	52242	47758	02283
26	49996	97713	52284	47716	02287
27	50034	97708	52326	47674	02292
28	50072	97704	52368	47632	02296
29	50110	97700	52410	47590	02300
30	9.50148	9.97696	9.52452	10.47548	10.02304
31	50185	97691	52494	47506	02309
32	50223	97687	52536	47464	02313
33	50261	97683	52578	47422	02317
34	50298	97679	52620	47380	02321
35	50336	97674	52661	47339	0232
36	50374	97670	52703	47297	0233
37	50411	97666	52745	47255	0233
38	50449	97662	52787	47213	0233
39	50486	97657	52829	47171	0234
40	9.50523	9.97653	9.52870	10.47130	10.0234
41	50561	97649	52912	47088	0235
42	50598	97645	52953	47047	0235
43	50635	97640	52995	47005	0236
44	50673	97636	53037	46963	0236
45	50710	97632	53078	46922	0236
		[illegible]	[illegible]	[illegible]	0237

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.51264	9.97567	9.53697	10.46303	10.02433	10.48736	60
1	51301	97563	53738	46262	02437	48699	59
2	51338	97558	53779	46221	02442	48662	58
3	51374	97554	53820	46180	02446	48626	57
4	51411	97550	53861	46139	02450	48589	56
5	51447	97545	53902	46098	02455	48553	55
6	51484	97541	53943	46057	02459	48516	54
7	51520	97536	53984	46016	02464	48480	53
8	51557	97532	54025	45975	02468	48443	52
9	51593	97528	54065	45935	02472	48407	51
10	9.51629	9.97523	9.54106	10.45894	10.02477	10.48371	50
11	51666	97519	54147	45853	02481	48334	49
12	51702	97515	54187	45813	02485	48298	48
13	51738	97510	54228	45772	02490	48262	47
14	51774	97506	54269	45731	02494	48226	46
15	51811	97501	54309	45691	02499	48189	45
16	51847	97497	54350	45650	02503	48153	44
17	51883	97492	54390	45610	02508	48117	43
18	51919	97488	54431	45569	02512	48081	42
19	51955	97484	54471	45529	02516	48045	41
20	9.51991	9.97479	9.54512	10.45488	10.02521	10.48009	40
21	52027	97475	54552	45448	02525	47973	39
22	52063	97470	54593	45407	02530	47937	38
23	52099	97466	54633	45367	02534	47901	37
24	52135	97461	54673	45327	02539	47865	36
25	52171	97457	54714	45286	02543	47829	35
26	52207	97453	54754	45246	02547	47793	34
27	52242	97448	54794	45206	02552	47758	33
28	52278	97444	54835	45165	02556	47722	32
29	52314	97439	54875	45125	02561	47686	31
30	9.52350	9.97435	9.54915	10.45085	10.02565	10.47650	30
31	52385	97430	54955	45045	02570	47615	29
32	52421	97426	54995	45005	02574	47579	28
33	52456	97421	55035	44965	02579	47544	27
34	52492	97417	55075	44925	02583	47508	26
35	52527	97412	55115	44885	02588	47473	25
36	52563	97408	55155	44845	02592	47437	24
37	52598	97403	55195	44805	02597	47402	23
38	52634	97399	55235	44765	02601	47366	22
39	52669	97394	55275	44725	02606	47331	21
40	9.52705	9.97390	9.55315	10.44685	10.02610	10.47295	20
41	52740	97385	55355	44645	02615	47260	19
42	52775	97381	55395	44605	02619	47225	18
43	52811	97376	55434	44566	02624	47189	17
44	52846	97372	55474	44526	02628	47154	16
45	52881	97367	55514	44486	02633	47119	15
46	52916	97363	55554	44446	02637	47084	14
47	52951	97358	55593	44407	02642	47049	13
48	52986	97353	55633	44367	02647	47014	12
49	53021	97349	55673	44327	02651	46979	11
50	9.53056	9.97344	9.55712	10.44288	10.02656	10.46944	10
51	53092	97340	55752	44248	02660	46908	9
52	53126	97335	55791	44209	02665	46874	8
53	53161	97331	55831	44169	02669	46839	7
54	53196	97326	55870	44130	02674	46804	6
55	53231	97322	55910	44090	02678	46769	5
56	53266	97317	55949	44051	02683	46734	4
57	53301	97312	55989	44011	02688	46699	3
58	53336	97308	56028	43972	02692	46664	2
59	53370	97303	56067	43933	02697	46630	1
60	53405	97299	56107	43893	02701	46595	0
-	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
9.97299	9.56107	10.43893	10.02701	10.46595	60
97294	56146	43854	02706	46560	59
97289	56185	43815	02711	46525	58
97285	56224	43776	02715	46491	57
97280	56264	43736	02720	46456	56
97276	56303	43697	02724	46422	55
97271	56342	43658	02729	46387	54
97266	56381	43619	02734	46353	53
97262	56420	43580	02738	46318	52
97257	56459	43541	02743	46284	51
9.97252	9.56498	10.43502	10.02748	10.46249	50
97248	56537	43463	02752	46215	49
97243	56576	43424	02757	46181	48
97238	56615	43385	02762	46146	47
97234	56654	43346	02766	46112	46
97229	56693	43307	02771	46078	45
97224	56732	43268	02776	46043	44
97220	56771	43229	02780	46009	43
97215	56810	43190	02785	45975	42
97210	56849	43151	02790	45941	41
9.97206	9.56887	10.43113	10.02794	10.45907	40
97201	56926	43074	02799	45873	39
97196	56965	43035	02804	45839	38
97192	57004	42996	02808	45805	37
97187	57042	42958	02813	45771	36
97182	57081	42919	02818	45737	35
97178	57120	42880	02822	45703	34
97173	57158	42842	02827	45669	33
97168	57197	42803	02832	45635	32
97163	57235	42765	02837	45601	31
9.97159	9.57274	10.42726	10.02841	10.45567	30
97154	57312	42688	02846	45534	29

TABLE V. Of Artificial Sines, Tangents, and Secants. 21 Degs.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.55483	9.97015	9.58418	10.41582	10.02985	10.44567	60
1	55466	97010	58455	41545	02990	44534	59
2	55499	97005	58493	41507	02995	44501	58
3	55532	97001	58531	41469	02999	44468	57
4	55564	96996	58569	41431	03004	44436	56
5	55597	96991	58606	41394	03009	44403	55
6	55630	96986	58644	41356	03014	44370	54
7	55663	96981	58681	41319	03019	44337	53
8	55695	96976	58719	41281	03024	44305	52
9	55728	96971	58757	41243	03029	44272	51
10	9.55761	9.96966	9.58794	10.41206	10.03034	10.44239	50
11	55793	96962	58832	41168	03038	44207	49
12	55826	96957	58869	41131	03043	44174	48
13	55858	96952	58907	41093	03048	44142	47
14	55891	96947	58944	41056	03053	44109	46
15	55923	96942	58981	41019	03058	44077	45
16	55956	96937	59019	40981	03063	44044	44
17	55988	96932	59056	40944	03068	44012	43
18	56021	96927	59094	40906	03073	43979	42
19	56053	96922	59131	40869	03078	43947	41
20	9.56085	9.96917	9.59168	10.40832	10.03083	10.43915	40
21	56118	96912	59205	40795	03088	43882	39
22	56150	96907	59243	40757	03093	43850	38
23	56182	96903	59280	40720	03097	43818	37
24	56215	96898	59317	40683	03102	43785	36
25	56247	96893	59354	40646	03107	43753	35
26	56279	96888	59391	40609	03112	43721	34
27	56311	96883	59429	40571	03117	43689	33
28	56343	96878	59466	40534	03122	43657	32
29	56375	96873	59503	40497	03127	43625	31
30	9.56408	9.96868	9.59540	10.40460	10.03132	10.43592	30
31	56440	96863	59577	40423	03137	43560	29
32	56472	96858	59614	40386	03142	43528	28
33	56504	96853	59651	40349	03147	43496	27
34	56536	96848	59688	40312	03152	43464	26
35	56568	96843	59725	40275	03157	43432	25
36	56599	96838	59762	40238	03162	43401	24
37	56631	96833	59799	40201	03167	43369	23
38	56663	96828	59835	40165	03172	43337	22
39	56695	96823	59872	40128	03177	43305	21
40	9.56727	9.96818	9.59909	10.40091	10.03182	10.43273	20
41	56759	96813	59946	40054	03187	43241	19
42	56790	96808	59983	40017	03192	43210	18
43	56822	96803	60019	39981	03197	43178	17
44	56854	96798	60056	39944	03202	43146	16
45	56886	96793	60093	39907	03207	43114	15
46	56917	96788	60130	39870	03212	43083	14
47	56949	96783	60166	39834	03217	43051	13
48	56980	96778	60203	39797	03222	43020	12
49	57012	96772	60240	39760	03228	42988	11
50	9.57044	9.96767	9.60276	10.39724	10.03233	10.42956	10
51	57075	96762	60313	39687	03238	42925	9
52	57107	96757	60349	39651	03243	42893	8
53	57138	96752	60386	39614	03248	42862	7
54	57169	96747	60422	39578	03253	42831	6
55	57201	96742	60459	39541	03258	42799	5
56	57232	96737	60495	39505	03263	42768	4
57	57264	96732	60532	39468	03268	42736	3
58	57295	96727	60568	39432	03273	42705	2
59	57326	96722	60605	39395	03278	42674	1
60	57358	96717	60641	39359	03283	42642	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
.96717	9.60641	10.39359	10.03283	10.42642	60
96711	60677	39323	03289	42611	59
96706	60714	39286	03294	42580	58
96701	60750	39250	03299	42549	57
96696	60786	39214	03304	42518	56
96691	60823	39177	03309	42486	55
96686	60859	39141	03314	42455	54
96681	60895	39105	03319	42424	53
96676	60931	39069	03324	42393	52
96670	60967	39033	03330	42362	51
.96665	9.61004	10.38996	10.03335	10.42331	50
96660	61040	38960	03340	42300	49
96655	61076	38924	03345	42269	48
96650	61112	38888	03350	42238	47
96645	61148	38852	03355	42207	46
96640	61184	38816	03360	42176	45
96634	61220	38780	03366	42145	44
96629	61256	38744	03371	42115	43
96624	61292	38708	03376	42084	42
96619	61328	38672	03381	42053	41
9.96614	9.61364	10.38636	10.03386	10.42022	40
96608	61400	38600	03392	41992	39
96603	61436	38564	03397	41961	38
96598	61472	38528	03402	41930	37
96593	61508	38492	03407	41899	36
96588	61544	38456	03412	41869	35
96582	61579	38421	03418	41838	34
96577	61615	38385	03423	41808	33
96572	61651	38349	03428	41777	32
96567	61687	38313	03433	41747	31
9.96562	9.61722	10.38278	10.03438	10.41716	30

TABLE V. OF ARTIFICIAL SINES, TANGENTS, AND SECANTS. 23 DEGS.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.59188	9.96403	9.62785	10.37215	10.03597	10.40812	60
1	59218	96397	62820	37180	03603	40782	59
2	59247	96392	62855	37145	03608	40753	58
3	59277	96387	62890	37110	03613	40723	57
4	59307	96381	62926	37074	03619	40693	56
5	59336	96376	62961	37039	03624	40664	55
6	59366	96370	62996	37004	03630	40634	54
7	59396	96365	63031	36969	03635	40604	53
8	59425	96360	63066	36934	03640	40575	52
9	59455	96354	63101	36899	03646	40545	51
10	9.59484	9.96349	9.63135	10.36865	10.03651	10.40516	50
11	59514	96343	63170	36830	03657	40486	49
12	59543	96338	63205	36795	03662	40457	48
13	59573	96333	63240	36760	03667	40427	47
14	59602	96327	63275	36725	03673	40398	46
15	59632	96322	63310	36690	03678	40368	45
16	59661	96316	63345	36655	03684	40339	44
17	59690	96311	63379	36621	03689	40310	43
18	59720	96305	63414	36586	03695	40280	42
19	59749	96300	63449	36551	03700	40251	41
20	9.59778	9.96294	9.63484	10.36516	10.03706	10.40222	40
21	59808	96289	63519	36481	03711	40192	39
22	59837	96284	63553	36447	03716	40163	38
23	59866	96278	63588	36412	03722	40134	37
24	59895	96273	63623	36377	03727	40105	36
25	59924	96267	63657	36343	03733	40076	35
26	59954	96262	63692	36308	03738	40046	34
27	59983	96256	63726	36274	03744	40017	33
28	60012	96251	63761	36239	03749	39988	32
29	60041	96245	63796	36204	03755	39959	31
30	9.60070	9.96240	9.63830	10.36170	10.03760	10.39930	30
31	60099	96234	63865	36135	03766	39901	29
32	60128	96229	63899	36101	03771	39872	28
33	60157	96223	63934	36066	03777	39843	27
34	60186	96218	63968	36032	03782	39814	26
35	60215	96212	64003	35997	03788	39785	25
36	60244	96207	64037	35963	03793	39756	24
37	60273	96201	64072	35928	03799	39727	23
38	60302	96196	64106	35894	03804	39698	22
39	60331	96190	64140	35860	03810	39669	21
40	9.60359	9.96185	9.64175	10.35825	10.03815	10.39641	20
41	60388	96179	64209	35791	03821	39612	19
42	60417	96174	64243	35757	03826	39583	18
43	60446	96168	64278	35722	03832	39554	17
44	60474	96162	64312	35688	03838	39526	16
45	60503	96157	64346	35654	03843	39497	15
46	60532	96151	64381	35619	03849	39468	14
47	60561	96146	64415	35585	03854	39439	13
48	60589	96140	64449	35551	03860	39411	12
49	60618	96135	64483	35517	03865	39382	11
50	9.60646	9.96129	9.64517	10.35483	10.03871	10.39354	10
51	60675	96123	64552	35448	03877	39325	9
52	60704	96118	64586	35414	03882	39296	8
53	60732	96112	64620	35380	03888	39268	7
54	60761	96107	64654	35346	03893	39239	6
55	60789	96101	64688	35312	03899	39211	5
56	60818	96095	64722	35278	03905	39182	4
57	60846	96090	64756	35244	03910	39154	3
58	60875	96084	64790	35210	03916	39125	2
59	60903	96079	64824	35176	03921	39097	1
60	60931	96073	64858	35142	03927	39069	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.60931	9.96073	9.64858	10.35142	10.03927	10.39069	60
1	60960	96067	64892	35108	03933	39040	59
2	60988	96062	64926	35074	03938	39012	58
3	61016	96056	64960	35040	03944	38984	57
4	61045	96050	64994	35006	03950	38955	56
5	61073	96045	65028	34972	03955	38927	55
6	61101	96039	65062	34938	03961	38899	54
7	61129	96034	65096	34904	03966	38871	53
8	61158	96028	65130	34870	03972	38842	52
9	61186	96022	65164	34836	03978	38814	51
10	9.61214	9.96017	9.65197	10.34803	10.03983	10.38786	50
11	61242	96011	65231	34769	03989	38758	49
12	61270	96005	65265	34735	03995	38730	48
13	61298	96000	65299	34701	04000	38702	47
14	61326	95994	65333	34667	04006	38674	46
15	61354	95988	65366	34634	04012	38646	45
16	61382	95982	65400	34600	04018	38618	44
17	61411	95977	65434	34566	04023	38589	43
18	61438	95971	65467	34533	04029	38562	42
19	61466	95965	65501	34499	04035	38534	41
20	9.61494	9.95960	9.65535	10.34465	10.04040	10.38506	40
21	61522	95954	65568	34432	04046	38478	39
22	61550	95948	65602	34398	04052	38450	38
23	61578	95942	65636	34364	04058	38422	37
24	61606	95937	65669	34331	04063	38394	36
25	61634	95931	65703	34297	04069	38366	35
26	61662	95925	65736	34264	04075	38338	34
27	61689	95920	65770	34230	04080	38311	33
28	61717	95914	65803	34197	04086	38283	32
29	61745	95908	65837	34163	04092	38255	31
30	9.61773	9.95902	9.65870	10.34130	10.04098	10.38227	30
31	61800	95897	65904	34096	04103	38200	29
32	61828	95891	65937	34063	04109	38172	28
33	61856	95885	65971	34029	04115	38144	27
34	61883	95879	66004	33996	04121	38117	26
35	61911	95873	66038	33962	04127	38089	25
36	61939	95868	66071	33929	04132	38061	24
37	61966	95862	66104	33896	04138	38034	23
38	61994	95856	66138	33862	04144	38006	22
39	62021	95850	66171	33829	04150	37979	21
40	9.62049	9.95844	9.66204	10.33796	10.04156	10.37951	20
41	62076	95839	66238	33762	04161	37924	19
42	62104	95833	66271	33729	04167	37896	18
43	62131	95827	66304	33696	04173	37869	17
44	62159	95821	66337	33663	04179	27841	16
45	62186	95815	66371	33629	04185	37814	15
46	62214	95810	66404	33596	04190	37786	14
47	62241	95804	66437	33563	04196	37759	13
48	62268	95798	66470	33530	04202	37732	12
49	62296	95792	66503	33497	04208	37704	11
50	9.62323	9.95786	9.66537	10.33463	10.04214	10.37657	10
51	62350	95780	66570	33430	04220	37650	9
52	62377	95775	66603	33397	04225	37623	8
53	62405	95769	66636	33364	04231	37595	7
54	62432	95763	66669	33331	04237	37568	6
55	62459	95757	66702	33298	04243	37541	5
56	62486	95751	66735	33265	04249	37514	4
57	62513	95745	66768	33232	04255	37487	3
58	62541	95739	66801	33199	04261	37459	2
59	62568	95733	66834	33166	04266	37432	1
60	62595	95728	66867	33133	04272	37405	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.62595	9.95728	9.66867	10.33133	10.04272	10.37405	60
1	62622	95722	66900	33100	04278	37378	59
2	62649	95716	66933	33067	04284	37351	58
3	62676	95710	66966	33034	04290	37324	57
4	62703	95704	66999	33001	04296	37297	56
5	62730	95698	67032	32968	04302	37270	55
6	62757	95692	67065	32935	04308	37243	54
7	62784	95686	67098	32902	04314	37216	53
8	62811	95680	67131	32869	04320	37189	52
9	62838	95674	67163	32837	04326	37162	51
10	9.62865	9.95668	9.67196	10.32804	10.04332	10.37135	50
11	62892	95663	67229	32771	04337	37108	49
12	62918	95657	67262	32738	04343	37082	48
13	62945	95651	67295	32705	04349	37055	47
14	62972	95645	67327	32673	04355	37028	46
15	62999	95639	67360	32640	04361	37001	45
16	63026	95633	67393	82607	04367	36974	44
17	63052	95627	67426	32574	04373	36948	43
18	63079	95621	67458	32542	04379	36921	42
19	63106	95615	67491	32509	04385	36894	41
20	9.63133	9.95609	9.67524	10.32476	10.04391	10.36867	40
21	63159	95603	67556	32444	04397	36841	39
22	63186	95597	67589	32411	04403	36814	38
23	63213	95591	67622	32378	04409	36787	37
24	63239	95585	67654	32346	04415	36761	36
25	63266	95579	67687	32313	04421	36734	35
26	63292	95573	67719	32281	04427	36708	34
27	63319	95567	67752	32248	04433	36681	33
28	63345	95561	67785	32215	04439	36655	32
29	63372	95555	67817	32183	04445	36628	31
30	9.63398	9.95549	9.67850	10.32150	10.04451	10.36602	30
31	63425	95543	67882	32118	04457	36575	29
32	63451	95537	67915	32085	04463	36549	28
33	63478	95531	67947	32053	04469	36522	27
34	63504	95525	67980	32020	04475	36496	26
35	63531	95519	68012	31988	04481	36469	25
36	63557	95513	68044	31956	04487	36443	24
37	63583	95507	68077	31923	04493	36417	23
38	63610	95500	68109	31891	04500	36390	22
39	63636	95494	68142	31858	04506	36364	21
40	9.63662	9.95488	9.68174	10.31826	10.04512	10.36338	20
41	63689	95482	68206	31794	04518	36311	19
42	63715	95476	68239	31761	04524	36285	18
43	63741	95470	68271	31729	04530	36259	17
44	63767	95464	68303	31697	04536	36233	16
45	63794	95458	68336	31664	04542	36206	15
46	63820	95452	68368	31632	04548	36180	14
47	63846	95446	68400	31600	04554	36154	13
48	63872	95440	68432	31568	04560	36128	12
49	63898	95434	68465	31535	04566	36102	11
50	9.63924	9.95427	9.68497	10.31503	10.04573	10.36076	10
51	63976	95421	68529	31471	04579	36050	9
52	64002	95415	68561	31439	04585	36024	8
53	64028	95409	68593	31407	04591	35998	7
54	64054	95403	68626	31374	04597	35972	6
55	64080	95397	68658	31342	04603	35946	5
56	64106	95391	68690	31310	04609	35920	4
57	64132	95384	68722	31278	04616	35894	3
58	64158	95378	68754	31246	04622	35868	2
59	64184	95372	68786	31214	04628	35842	1
60	63950	95366	68818	31182	04634	35816	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

64 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.44034	9.98284	9.45750	10.54250	10.01716	10.55966	60
1	44078	98281	45797	54203	01719	55922	59
2	44122	98277	45845	54155	01723	55878	58
3	44166	98273	45892	54108	01727	55834	57
4	44210	98270	45940	54060	01730	55790	56
5	44253	98266	45987	54013	01734	55747	55
6	44297	98262	46035	53965	01738	55703	54
7	44341	98259	46082	53918	01741	55659	53
8	44385	98255	46130	53870	01745	55615	52
9	44428	98251	46177	53823	01749	55572	51
10	9.44472	9.98248	9.46224	10.53776	10.01752	10.55528	50
11	44516	98244	46271	53729	01756	55484	49
12	44559	98240	46319	53681	01760	55441	48
13	44602	98237	46366	53634	01763	55398	47
14	44646	98233	46413	53587	01767	55354	46
15	44689	98229	46460	53540	01771	55311	45
16	44733	98226	46507	53493	01774	55267	44
17	44776	98222	46554	53446	01778	55224	43
18	44819	98218	46601	53399	01782	55181	42
19	44862	98215	46648	53352	01785	55138	41
20	9.44905	9.98211	9.46694	10.53306	10.01789	10.55095	40
21	44948	98207	46741	53259	01793	55052	39
22	44992	98204	46788	53212	01796	55008	38
23	45035	98200	46835	53165	01800	54965	37
24	45077	98196	46881	53119	01804	54923	36
25	45120	98192	46928	53072	01808	54880	35
26	45163	98189	46975	53025	01811	54837	34
27	45206	98185	47021	52979	01815	54794	33
28	45249	98181	47068	52932	01819	54751	32
29	45292	98177	47114	52886	01823	54708	31
30	9.45334	9.98174	9.47160	10.52840	10.01826	10.54666	30
31	45377	98170	47207	52793	[illegible]	[illegible]	[illegible]

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.65705	9.94988	9.70717	10.29283	10.05012	10.34295	60
1	65729	94982	70748	29252	05018	34271	59
2	65754	94975	70779	29221	05025	34246	58
3	65779	94969	70810	29190	05031	34221	57
4	65804	94962	70841	29159	05038	34196	56
5	65828	94956	70873	29127	05044	34172	55
6	65853	94949	70904	29096	05051	34147	54
7	65878	94943	70935	29065	05057	34122	53
8	65902	94936	70966	29034	05064	34098	52
9	65927	94930	70997	29003	05070	34073	51
10	9.65952	9.94928	9.71028	10.28972	10.05077	10.34048	50
11	65976	94917	71059	28941	05083	34024	49
12	66001	94911	71090	28910	05089	33999	48
13	66025	94904	71121	28879	05096	33975	47
14	66050	94898	71153	28847	05102	33950	46
15	66075	94891	71184	28816	05109	33925	45
16	66099	94885	71215	28785	05115	33901	44
17	66124	94878	71246	28754	05122	33876	43
18	66148	94871	71277	28723	05129	33852	42
19	66173	94865	71308	28692	05135	33827	41
20	9.66197	9.94858	9.71339	10.28661	10.05142	10.33803	40
21	66221	94852	71370	28630	05148	33779	39
22	66246	94845	71401	28599	05155	33754	38
23	66270	94839	71431	28569	05161	33730	37
24	66295	94832	71462	28538	05168	33705	36
25	66319	94826	71493	28507	05174	33681	35
26	66343	94819	71524	28476	05181	33657	34
27	66368	94813	71555	28445	05187	33632	33
28	66392	94806	71586	28414	05194	33608	32
29	66416	94799	71617	28383	05201	33584	31
30	9.66441	9.94793	9.71648	10.28352	10.05207	10.33559	30
31	66465	94786	71679	28321	05214	33535	29
32	66489	94780	71709	28291	05220	33511	28
33	66513	94773	71740	28260	05227	33487	27
34	66537	94767	71771	28229	05233	33463	26
35	66562	94760	71802	28198	05240	33438	25
36	66586	94753	71833	28167	05247	33414	24
37	66610	94747	71863	28137	05253	33390	23
38	66634	94740	71894	28106	05260	33366	22
39	66658	94734	71925	28075	05266	33342	21
40	9.66682	9.94727	9.71955	10.28045	10.05273	10.33318	20
41	66706	94720	71986	28014	05280	33294	19
42	66731	94714	72017	27983	05286	33269	18
43	66755	94707	72048	27952	05293	33245	17
44	66779	94700	72078	27922	05300	33221	16
45	66803	94694	72109	27891	05306	33197	15
46	66827	94687	72140	27860	05313	33173	14
47	66851	94680	72170	27830	05320	33149	13
48	66875	94674	72201	27799	05326	33125	12
49	66899	94667	72231	27769	05333	33101	11
50	9.66922	9.94660	9.72262	10.27738	10.05340	10.33078	10
51	66946	94654	72293	27707	05346	33054	9
52	66970	94647	72323	27677	05353	33030	8
53	66994	94640	72354	27646	05360	33006	7
54	67018	94634	72384	27616	05366	32982	6
55	67042	94627	72415	27585	05373	32958	5
56	67066	94620	72445	27555	05380	32934	4
57	67090	94614	72476	27524	05386	32910	3
58	67113	94607	72506	27494	05393	32887	2
59	67137	94600	72537	27463	05400	32863	1
60	67161	94593	72567	27433	05407	32839	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.67161	9.94593	9.72567	10.27433	10.05407	10.32839	60
1	67185	94587	72598	27402	05413	32815	59
2	67208	94580	72628	27372	05420	32792	58
3	67232	94573	72659	27341	05427	32768	57
4	67256	94567	72689	27311	05433	32744	56
5	67280	94560	72720	27280	05440	32720	55
6	67303	94553	72750	27250	05447	32697	54
7	67327	94546	72780	27220	05454	32673	53
8	67350	94540	72811	27189	05460	32650	52
9	67374	94533	72841	27159	05467	32626	51
10	9.67398	9.94526	9.72872	10.27128	10.05474	10.32602	50
11	67421	94519	72902	27098	05481	32579	49
12	67445	94513	72932	27068	05487	32555	48
13	67468	94606	72963	27037	05494	32532	47
14	67492	94499	72993	27007	05501	32508	46
15	67515	94492	73023	26977	05508	32485	45
16	67539	94485	73054	26946	05515	32461	44
17	67562	94479	73084	26916	05521	32438	43
18	67586	94472	73114	26886	05528	32414	42
19	67609	94465	73144	26856	05535	32391	41
20	9.67633	9.94458	9.73175	10.26825	10.05542	10.32367	40
21	67656	94451	73205	26795	05549	32344	39
22	67680	94445	73235	26765	05555	32320	38
23	67703	94438	73265	26735	05562	32297	37
24	67726	94431	73295	26705	05569	32274	36
25	67750	94424	73326	26674	05576	32250	35
26	67773	94417	73356	26644	05583	32227	34
27	67796	94410	73386	26614	05590	32204	33
28	67820	94404	73416	26584	05596	32180	32
29	67843	94397	73446	26554	05603	32157	31
30	9.67866	9.94390	9.73476	10.26524	10.05610	10.32134	30
31	67890	94383	73507	26493	05617	32110	29
32	67913	94376	73537	26463	05624	32087	28
33	67936	94369	73567	26433	05631	32064	27
34	67959	94362	73597	26403	05638	32041	26
35	67982	94355	73627	26373	05645	32018	25
36	68006	94349	73657	26343	05651	31994	24
37	68029	94342	73687	26313	05658	31971	23
38	68052	94335	73717	26283	05665	31948	22
39	68075	94328	73747	26253	05672	31925	21
40	9.68098	9.94321	9.73777	10.26223	10.05679	10.31902	20
41	68121	94314	73807	26193	05686	31879	19
42	68144	94307	73837	26163	05693	31856	18
43	68167	94300	73867	26133	05700	31833	17
44	68190	94293	73897	26103	05707	31810	16
45	68213	94286	73927	26073	05714	31787	15
46	68237	94279	73957	26043	05721	31763	14
47	68260	94273	73987	26013	05727	31740	13
48	68282	94266	74017	25983	05734	31718	12
49	68305	94259	74047	25953	05741	31695	11
50	9.68328	9.94252	9.74077	10.25923	10.05748	10.31672	10
51	68351	94245	74107	25893	05755	31649	9
52	68374	94238	74137	25863	05762	31626	8
53	68397	94231	74166	25834	05769	31603	7
54	68420	94224	74196	25804	05776	31580	6
55	68443	94217	74226	25774	05783	31557	5
56	68466	94210	74256	25744	05790	31534	4
57	68489	94203	74286	25714	05797	31511	3
58	68512	94196	74316	25684	05804	31488	2
59	68534	94189	74345	25655	05811	31466	1
60	68557	94192	74375	25625	05818	31443	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

61 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.51264	9.97567	9.53697	10.46303	10.02433	10.48736	60
1	51301	97563	53738	46262	02437	48699	59
2	51338	97558	53779	46221	02442	48662	58
3	51374	97554	53820	46180	02446	48626	57
4	51411	97550	53861	46139	02450	48589	56
5	51447	97545	53902	46098	02455	48553	55
6	51484	97541	53943	46057	02459	48516	54
7	51520	97536	53984	46016	02464	48480	53
8	51557	97532	54025	45975	02468	48443	52
9	51593	97528	54065	45935	02472	48407	51
10	9.51629	9.97523	9.54106	10.45894	10.02477	10.48371	50
11	51666	97519	54147	45853	02481	48334	49
12	51702	97515	54187	45813	02485	48298	48
13	51738	97510	54228	45772	02490	48262	47
14	51774	97506	54269	45731	02494	48226	46
15	51811	97501	54309	45691	02499	48189	45
16	51847	97497	54350	45650	02503	48153	44
17	51883	97492	54390	45610	02508	48117	43
18	51919	97488	54431	45569	02512	48081	42
19	51955	97484	54471	45529	02516	48045	41
20	9.51991	9.97479	9.54512	10.45488	10.02521	10.48009	40
21	52027	97475	54552	45448	02525	47973	39
22	52063	97470	54593	45407	02530	47937	38
23	52099	97466	54633	45367	02534	47901	37
24	52135	97461	54673	45327	02539	47865	36
25	52171	97457	54714	45286	02543	47829	35
26	52207	97453	54754	45246	02547	47793	34
27	52242	97448	54794	45206	02552	47758	33
28	52278	97444	54835	45165	02556	47722	32
29	52314	97439	54875	45125	02561	47686	31
30	9.52350	9.97435	9.54915	10.45085	10.02565	10.47650	30
31	52385	97430	54955	45045	02570	47615	29
32	52421	97426	54995	45005	02574	47579	28
33	52456	97421	55035	44965	02579	47544	27
34	52492	97417	55075	44925	02583	47508	26
35	52527	97412	55115	44885	02588	47473	25
36	52563	97408	55155	44845	02592	47437	24
37	52598	97403	55195	44805	02597	47402	23
38	52634	97399	55235	44765	02601	47366	22
39	52669	97394	55275	44725	02606	47331	21
40	9.52705	9.97390	9.55315	10.44685	10.02610	10.47295	20
41	52740	97385	55355	44645	02615	47260	19
42	52775	97381	55395	44605	02619	47225	18
43	52811	97376	55434	44566	02624	47189	17
44	52846	97372	55474	44526	02628	47154	16
45	52881	97367	55514	44486	02633	47119	15
46	52916	97363	55554	44446	02637	47084	14
47	52951	97358	55593	44407	02642	47049	13
48	52986	97353	55633	44367	02647	47014	12
49	53021	97349	55673	44327	02651	46979	11
50	9.53056	9.97344	9.55712	10.44288	10.02656	10.46944	10
51	53092	97340	55752	44248	02660	46908	9
52	53126	97335	55791	44209	02665	46874	8
53	53161	97331	55831	44169	02669	46839	7
54	53196	97326	55870	44130	02674	46804	6
55	53231	97322	55910	44090	02678	46769	5
56	53266	97317	55949	44051	02683	46734	4
57	53301	97312	55989	44011	02688	46699	3
58	53336	97308	56028	43972	02692	46664	2
59	53370	97303	56067	43933	02697	46630	1
60	53405	97299	56107	43893	02701	46595	0
-	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M

Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	
9.93753	9.76144	10.23856	10.06247	10.30103	60
93746	76173	23827	06254	30081	59
93738	76202	23798	06262	30059	58
93731	76231	23769	06269	30037	57
93724	76261	23739	06276	30016	56
93717	76290	23710	06283	29994	55
93709	76319	23681	06291	29972	54
93702	76348	23652	06298	29950	53
93695	76377	23623	06305	29928	52
93687	76406	23594	06313	29907	51
9.93680	9.76435	10.23565	10.06320	10.29885	50
93673	76464	23536	06327	29863	49
93665	76493	23507	06335	29841	48
93658	76522	23478	06342	29820	47
93650	76551	23449	06350	29798	46
93643	76580	23420	06357	29776	45
93636	76609	23391	06364	29755	44
93628	76639	23361	06372	29733	43
93621	76668	23332	06379	29712	42
93614	76697	23303	06386	29690	41
9.93606	9.76725	10.23275	10.06394	10.29668	40
93599	76754	23246	06401	29647	39
93591	76783	23217	06409	29625	38
93584	76812	23188	06416	29604	37
93577	76841	23159	06423	29582	36
93569	76870	23130	06431	29561	35
93562	76899	23101	06438	29539	34
93554	76928	23072	06446	29518	33
93547	76957	23043	06453	29496	32
93539	76986	23014	06461	29475	31
9.93532	9.77015	10.22985	10.06468	10.29453	30
93525	77044	22956	06475	29432	29

TABLE V. OF ARTIFICIAL SINES, TANGENTS, AND SECANTS. 21 DEGS.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.55433	9.97015	9.58418	10.41582	10.02985	10.44567	60
1	55466	97010	58455	41545	02990	44534	59
2	55499	97005	58493	41507	02995	44501	58
3	55532	97001	58531	41469	02999	44468	57
4	55564	96996	58569	41431	03004	44436	56
5	55597	96991	58606	41394	03009	44403	55
6	55630	96986	58644	41356	03014	44370	54
7	55663	96981	58681	41319	03019	44337	53
8	55695	96976	58719	41281	03024	44305	52
9	55728	96971	58757	41243	03029	44272	51
10	9.55761	9.96966	9.58794	10.41206	10.03034	10.44239	50
11	55793	96962	58832	41168	03038	44207	49
12	55826	96957	58869	41131	03043	44174	48
13	55858	96952	58907	41093	03048	44142	47
14	55891	96947	58944	41056	03053	44109	46
15	55923	96942	58981	41019	03058	44077	45
16	55956	96937	59019	40981	03063	44044	44
17	55988	96932	59056	40944	03068	44012	43
18	56021	96927	59094	40906	03073	43979	42
19	56053	96922	59131	40869	03078	43947	41
20	9.56085	9.96917	9.59168	10.40832	10.03083	10.43915	40
21	56118	96912	59205	40795	03088	43882	39
22	56150	96907	59243	40757	03093	43850	38
23	56182	96903	59280	40720	03097	43818	37
24	56215	96898	59317	40683	03102	43785	36
25	56247	96893	59354	40646	03107	43753	35
26	56279	96888	59391	40609	03112	43721	34
27	56311	96883	59429	40571	03117	43689	33
28	56343	96878	59466	40534	03122	43657	32
29	56375	96873	59503	40497	03127	43625	31
30	9.56408	9.96868	9.59540	10.40460	10.03132	10.43592	30
31	56440	96863	59577	40423	03137	43560	29
32	56472	96858	59614	40386	03142	43528	28
33	56504	96853	59651	40349	03147	43496	27
34	56536	96848	59688	40312	03152	43464	26
35	56568	96843	59725	40275	03157	43432	25
36	56599	96838	59762	40238	03162	43401	24
37	56631	96833	59799	40201	03167	43369	23
38	56663	96828	59835	40165	03172	43337	22
39	56695	96823	59872	40128	03177	43305	21
40	9.56727	9.96818	9.59909	10.40091	10.03182	10.43273	20
41	56759	96813	59946	40054	03187	43241	19
42	56790	96808	59983	40017	03192	43210	18
43	56822	96803	60019	39981	03197	43178	17
44	56854	96798	60056	39944	03202	43146	16
45	56886	96793	60093	39907	03207	43114	15
46	56917	96788	60130	39870	03212	43083	14
47	56949	96783	60166	39834	03217	43051	13
48	56980	96778	60203	39797	03222	43020	12
49	57012	96772	60240	39760	03228	42988	11
50	9.57044	9.96767	9.60276	10.39724	10.03233	10.42956	10
51	57075	96762	60313	39687	03238	42925	9
52	57107	96757	60349	39651	03243	42893	8
53	57138	96752	60386	39614	03248	42862	7
54	57169	96747	60422	39578	03253	42831	6
55	57201	96742	60459	39541	03258	42799	5
56	57232	96737	60495	39505	03263	42768	4
57	57264	96732	60532	39468	03268	42736	3
58	57295	96727	60568	39432	03273	42705	2
59	57326	96722	60605	39395	03278	42674	1
60	57358	96717	60641	39359	03283	42642	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
9.92842	9.79579	10.20421	10.07158	10.27579	60
92834	79607	20393	07166	27559	59
92826	79635	20365	07174	27539	58
92818	79663	20337	07182	27518	57
92810	79691	20309	07190	37498	56
92803	79719	20281	07197	27478	55
92795	79747	20253	07205	27458	54
92787	79776	20224	07213	27438	53
92779	79804	20196	07221	27418	52
92771	79832	20168	07229	27398	51
9.92763	9.79860	10.20140	10.07237	10.27378	50
92755	79888	20112	07245	27357	49
92747	79916	20084	07253	27337	48
92739	79944	20056	07261	27317	47
92731	79972	20028	07269	27297	46
92723	80000	20000	07277	27277	45
92715	80028	19972	07285	27257	44
92707	80056	19944	07293	27237	43
92699	80084	19916	07301	27217	42
92691	80112	19888	07309	27197	41
9.92683	9.80140	10.19860	10.07317	10.27177	40
92675	80168	19832	07325	27157	39
92667	80195	19805	07333	27137	38
92659	80223	19777	07341	27117	37
92651	80251	19749	07349	27098	36
92643	80279	19721	07357	27078	35
92635	80307	19693	07365	27058	34
92627	80335	19665	07373	27038	33
92619	80363	19637	07381	27018	32
92611	80391	19609	07389	26998	31
9.92603	9.80419	10.19581	10.07397	10.26978	30
92595	80447	19553	07405	26959	29
92587	80474	19526	07413	26939	28

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.73611	9.92359	9.81252	10.18748	10.07641	10.26389	60
1	73630	92351	81279	18721	07649	26370	59
2	73650	92343	81307	18693	07657	26350	58
3	73669	92334	81335	18665	07666	26331	57
4	73689	92326	81362	18638	07674	26311	56
5	73708	92318	81390	18610	07682	26292	55
6	73727	92310	81418	18582	07690	26273	54
7	73747	92302	81445	18555	07698	26253	53
8	73766	92293	81473	18527	07707	26234	52
9	73785	92285	81500	18500	07715	26215	51
10	9.73805	9.92277	9.81528	10.18472	10.07723	10.26195	50
11	73824	92269	81556	18444	07731	26176	49
12	73843	92260	81583	18417	07740	26157	48
13	73863	92252	81611	18389	07748	26137	47
14	73882	92244	81638	18362	07756	26118	46
15	73901	92235	81666	18334	07765	26099	45
16	73921	92227	81693	18307	07773	26079	44
17	73940	92219	81721	18279	07781	26060	43
18	73959	92211	81748	18252	07789	26041	42
19	73978	92202	81776	18224	07798	26022	41
20	9.73997	9.92194	9.81803	10.18197	10.07806	10.26003	40
21	74017	92186	81831	18169	07814	25983	39
22	74036	92177	81858	18142	07823	25964	38
23	74055	92169	81886	18114	07831	25945	37
24	74074	92161	81913	18087	07839	25926	36
25	74093	92152	81941	18059	07848	25907	35
26	74113	92144	81968	18032	07856	25887	34
27	74132	92136	81996	18004	07864	25868	33
28	74151	92127	82023	17977	07873	25849	32
29	74170	92119	82051	17949	07881	25830	31
30	9.74189	9.92111	9.82078	10.17922	10.07889	10.25811	30
31	74208	92102	82106	17894	07898	25792	29
32	74227	92094	82133	17867	07906	25773	28
33	74246	92086	82161	17839	07914	25754	27
34	74265	92077	82188	17812	07923	25735	26
35	74284	92069	82215	17785	07931	25716	25
36	74303	92060	82243	17757	07940	25697	24
37	74322	92052	82270	17730	07948	25678	23
38	74341	92044	82298	17702	07956	25659	22
39	74360	92035	82325	17675	07965	25640	21
40	9.74379	9.92027	9.82352	10.17648	10.07973	10.25621	20
41	74398	92018	82380	17620	07982	25602	19
42	74417	92010	82407	17593	07990	25583	18
43	74436	92002	82435	17565	07998	25564	17
44	74455	91993	82462	17538	08007	25545	16
45	74474	91985	82489	17511	08015	25526	15
46	74493	91976	82517	17483	08024	25507	14
47	74512	91968	82544	17456	08032	25488	13
48	74531	91959	82571	17429	08041	25469	12
49	74549	91951	82599	17401	08049	25451	11
50	9.74568	9.91942	9.82626	10.17374	10.08058	10.25432	10
51	74587	91934	82653	17347	08066	25413	9
52	74606	91925	82681	17319	08075	25394	8
53	74625	91917	82708	17292	08083	25375	7
54	74644	91908	82735	17265	08092	25356	6
55	74662	91900	82762	17238	08100	25338	5
56	74681	91891	82790	17210	08109	25319	4
57	74700	91883	82817	17183	08117	25300	3
58	74719	91874	82844	17156	08126	25281	2
59	74737	91866	82871	17129	08134	25263	1
60	74756	91857	82899	17101	08143	25244	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.64184	9.95366	9.68818	10.31182	10.04634	10.35816	60
1	64210	95360	68850	31150	04640	35790	59
2	64236	95354	68882	31118	04646	35764	58
3	64262	95348	68914	31086	04652	35738	57
4	64288	95341	68946	31054	04659	35712	56
5	64313	95335	68978	31022	04665	35687	55
6	64339	95329	69010	30990	04671	35661	54
7	64365	95323	69042	30958	04677	35635	53
8	64391	95317	69074	30926	04683	35609	52
9	64417	95310	69106	30894	04690	35583	51
10	9.64442	9.95304	9.69138	10.30862	10.04696	10.35558	50
11	64468	95298	69170	30830	04702	35532	49
12	64494	95292	69202	30798	04708	35506	48
13	64519	95286	69234	30766	04714	35481	47
14	64545	95279	69266	30734	04721	35455	46
15	64571	95273	69298	30702	04727	35429	45
16	64596	95267	69329	30671	04733	35404	44
17	64622	95261	69361	30639	04739	35378	43
18	64647	95254	69393	30607	04746	35353	42
19	64673	95248	69425	30575	04752	35327	41
20	9.64698	9.95242	9.69457	10.30543	10.04758	10.35302	40
21	64724	95236	69488	30512	04764	35276	39
22	64749	95229	69520	30480	04771	35251	38
23	64775	95223	69552	30448	04777	35225	37
24	64800	95217	69584	30416	04783	35200	36
25	64826	95211	69615	30385	04789	35174	35
26	64851	95204	69647	30353	04796	35149	34
27	64877	95198	69679	30321	04802	35123	33
28	64902	95192	69710	30290	04808	35098	32
29	64927	95185	69742	30258	04815	35073	31
30	9.64953	9.95179	9.69774	10.30226	10.04821	10.35047	30
31	64978	95173	69805	30195	04827	35022	29
32	65003	95167	69837	30163	04833	34997	28
33	65029	95160	69868	30132	04840	34971	27
34	65054	95154	69900	30100	04846	34946	26
35	65079	95148	69932	30068	04852	34921	25
36	65104	95141	69963	30037	04859	34896	24
37	65130	95135	69995	30005	04865	34870	23
38	65155	95129	70026	29974	04871	34845	22
39	65180	95122	70058	29942	04878	34820	21
40	9.65205	9.95116	9.70089	10.29911	10.04884	10.34795	20
41	65230	95110	70121	29879	04890	34770	19
42	65255	95103	70152	29848	04897	34745	18
43	65281	95097	70184	29816	04903	34719	17
44	65306	95090	70215	29785	04910	34694	16
45	65331	95084	70247	29753	04916	34669	15
46	65356	95078	70278	29722	04922	34644	14
47	65381	95071	70309	29691	04929	34619	13
48	65406	95065	70341	29659	04935	34594	12
49	65431	95059	70372	29628	04941	34569	11
50	9.65456	9.95052	9.70404	10.29596	10.04948	10.34544	10
51	65481	95046	70435	29565	04954	34519	9
52	65506	95039	70466	29534	04961	34494	8
53	65531	95033	70498	29502	04967	34469	7
54	65556	95027	70529	29471	04973	34444	6
55	65580	95020	70560	29440	04980	34420	5
56	65605	95014	70592	29408	04986	34395	4
57	65630	95007	70623	29377	04993	34370	3
58	65655	95001	70654	29346	04999	34345	2
59	65680	94995	70685	29315	05005	34320	1
60	65705	94988	70717	29283	05012	34295	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.65705	9.94988	9.70717	10.29283	10.05012	10.34295	60
1	65729	94982	70748	29252	05018	34271	59
2	65754	94975	70779	29221	05025	34246	58
3	65779	94969	70810	29190	05031	34221	57
4	65804	94962	70841	29159	05038	34196	56
5	65828	94956	70873	29127	05044	34172	55
6	65853	94949	70904	29096	05051	34147	54
7	65878	94943	70935	29065	05057	34122	53
8	65902	94936	70966	29034	05064	34098	52
9	65927	94930	70997	29003	05070	34073	51
10	9.65952	9.94923	9.71028	10.28972	10.05077	10.34048	50
11	65976	94917	71059	28941	05083	34024	49
12	66001	94911	71090	28910	05089	33999	48
13	66025	94904	71121	28879	05096	33975	47
14	66050	94898	71153	28847	05102	33950	46
15	66075	94891	71184	28816	05109	33925	45
16	66099	94885	71215	28785	05115	33901	44
17	66124	94878	71246	28754	05122	33876	43
18	66148	94871	71277	28723	05129	33852	42
19	66173	94865	71308	28692	05135	33827	41
20	9.66197	9.94858	9.71339	10.28661	10.05142	10.33803	40
21	66221	94852	71370	28630	05148	33779	39
22	66246	94845	71401	28599	05155	33754	38
23	66270	94839	71431	28569	05161	33730	37
24	66295	94832	71462	28538	05168	33705	36
25	66319	94826	71493	28507	05174	33681	35
26	66343	94819	71524	28476	05181	33657	34
27	66368	94813	71555	28445	05187	33632	33
28	66392	94806	71586	28414	05194	33608	32
29	66416	94799	71617	28383	05201	33584	31
30	9.66441	9.94793	9.71648	10.28352	10.05207	10.33559	30
31	66465	94786	71679	28321	05214	33535	29
32	66489	94780	71709	28291	05220	33511	28
33	66513	94773	71740	28260	05227	33487	27
34	66537	94767	71771	28229	05233	33463	26
35	66562	94760	71802	28198	05240	33438	25
36	66586	94753	71833	28167	05247	33414	24
37	66610	94747	71863	28137	05253	33390	23
38	66634	94740	71894	28106	05260	33366	22
39	66658	94734	71925	28075	05267	33342	21
40	9.66682	9.94727	9.71955	10.28045	10.05273	10.33318	20
41	66706	94720	71986	28014	05280	33294	19
42	66731	94714	72017	27983	05286	33269	18
43	66755	94707	72048	27952	05293	33245	17
44	66779	94700	72078	27922	05300	33221	16
45	66803	94694	72109	27891	05306	33197	15
46	66827	94687	72140	27860	05313	33173	14
47	66851	94680	72170	27830	05320	33149	13
48	66875	94674	72201	27799	05826	33125	12
49	66899	94667	72231	27769	05333	33101	11
50	9.66922	9.94660	9.72262	10.27738	10.05340	10.33078	10
51	66946	94654	72293	27707	05346	33054	9
52	66970	94647	72323	27677	05353	33030	8
53	66994	94640	72354	27646	05360	33006	7
54	67018	94634	72384	27616	05366	32982	6
55	67042	94627	72415	27585	05373	32958	5
56	67066	94620	72445	27555	05380	32934	4
57	67090	94614	72476	27524	05386	32910	3
58	67113	94607	72506	27494	05393	32887	2
59	67137	94600	72537	27463	05400	32863	1
60	67161	94593	72567	27433	05407	32839	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.64184	9.95366	9.68818	10.31182	10.04634	10.35816	60
1	64210	95360	68850	31150	04640	35790	59
2	64236	95354	68882	31118	04646	35764	58
3	64262	95348	68914	31086	04652	35738	57
4	64288	95341	68946	31054	04659	35712	56
5	64313	95335	68978	31022	04665	35687	55
6	64339	95329	69010	30990	04671	35661	54
7	64365	95323	69042	30958	04677	35635	53
8	64391	95317	69074	30926	04683	35609	52
9	64417	95310	69106	30894	04690	35583	51
10	9.64442	9.95304	9.69138	10.30862	10.04696	10.35558	50
11	64468	95298	69170	30830	04702	35532	49
12	64494	95292	69202	30798	04708	35506	48
13	64519	95286	69234	30766	04714	35481	47
14	64545	95279	69266	30734	04721	35455	46
15	64571	95273	69298	30702	04727	35429	45
16	64596	95267	69329	30671	04733	35404	44
17	64622	95261	69361	30639	04739	35378	43
18	64647	95254	69393	30607	04746	35353	42
19	64673	95248	69425	30575	04752	35327	41
20	9.64698	9.95242	9.69457	10.30543	10.04758	10.35302	40
21	64724	95236	69488	30512	04764	35276	39
22	64749	95229	69520	30480	04771	35251	38
23	64775	95223	69552	30448	04777	35225	37
24	64800	95217	69584	30416	04783	35200	36
25	64826	95211	69615	30385	04789	35174	35
26	64851	95204	69647	30353	04796	35149	34
27	64877	95198	69679	30321	04802	35123	33
28	64902	95192	69710	30290	04808	35098	32
29	64927	95185	69742	30258	04815	35073	31
30	9.64953	9.95179	9.69774	10.30226	10.04821	10.35047	30
31	64978	95173	69805	30195	04827	35022	29
32	65003	95167	69837	30163	04833	34997	28
33	65029	95160	69868	30132	04840	34971	27
34	65054	95154	69900	30100	04846	34946	26
35	65079	95148	69932	30068	04852	34921	25
36	65104	95141	69963	30037	04859	34896	24
37	65130	95135	69995	30005	04865	34870	23
38	65155	95129	70026	29974	04871	34845	22
39	65180	95122	70058	29942	04878	34820	21
40	9.65205	9.95116	9.70089	10.29911	10.04884	10.34795	20
41	65230	95110	70121	29879	04890	34770	19
42	65255	95103	70152	29848	04897	34745	18
43	65281	95097	70184	29816	04903	34719	17
44	65306	95090	70215	29785	04910	34694	16
45	65331	95084	70247	29753	04916	34669	15
46	65356	95078	70278	29722	04922	34644	14
47	65381	95071	70309	29691	04929	34619	13
48	65406	95065	70341	29659	04935	34594	12
49	65431	95059	70372	29628	04941	34569	11
50	9.65456	9.95052	9.70404	10.29596	10.04948	10.34544	10
51	65481	95046	70435	29565	04954	34519	9
52	65506	95039	70466	29534	04961	34494	8
53	65531	95033	70498	29502	04967	34469	7
54	65556	95027	70529	29471	04973	34444	6
55	65580	95020	70560	29440	04980	34420	5
56	65605	95014	70592	29408	04986	34395	4
57	65630	95007	70623	29377	04993	34370	3
58	65655	95001	70654	29346	04999	34345	2
59	65680	94995	70685	29315	05005	34320	1
60	65705	94988	70717	29283	05012	34295	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.65705	9.94988	9.70717	10.29283	10.05012	10.34295	60
1	65729	94982	70748	29252	05018	34271	59
2	65754	94975	70779	29221	05025	34246	58
3	65779	94969	70810	29190	05031	34221	57
4	65804	94962	70841	29159	05038	34196	56
5	65828	94956	70873	29127	05044	34172	55
6	65853	94949	70904	29096	05051	34147	54
7	65878	94943	70935	29065	05057	34122	53
8	65902	94936	70966	29034	05064	34098	52
9	65927	94930	70997	29003	05070	34073	51
10	9.65952	9.94923	9.71028	10.28972	10.05077	10.34048	50
11	65976	94917	71059	28941	05083	34024	49
12	66001	94911	71090	28910	05089	33999	48
13	66025	94904	71121	28879	05096	33975	47
14	66050	94898	71153	28847	05102	33950	46
15	66075	94891	71184	28816	05109	33925	45
16	66099	94885	71215	28785	05115	33901	44
17	66124	94878	71246	28754	05122	33876	43
18	66148	94871	71277	28723	05129	33852	42
19	66173	94865	71308	28692	05135	33827	41
20	9.66197	9.94858	9.71339	10.28661	10.05142	10.33803	40
21	66221	94852	71370	28630	05148	33779	39
22	66246	94845	71401	28599	05155	33754	38
23	66270	94839	71431	28569	05161	33730	37
24	66295	94832	71462	28538	05168	33705	36
25	66319	94826	71493	28507	05174	33681	35
26	66343	94819	71524	28476	05181	33657	34
27	66368	94813	71555	28445	05187	33632	33
28	66392	94806	71586	28414	05194	33608	32
29	66416	94799	71617	28383	05201	33584	31
30	9.66441	9.94793	9.71648	10.28352	10.05207	10.33559	30
31	66465	94786	71679	28321	05214	33535	29
32	66489	94780	71709	28291	05220	33511	28
33	66513	94773	71740	28260	05227	33487	27
34	66537	94767	71771	28229	05233	33463	26
35	66562	94760	71802	28198	05240	33438	25
36	66586	94753	71833	28167	05247	33414	24
37	66610	94747	71863	28137	05253	33390	23
38	66634	94740	71894	28106	05260	33366	22
39	66658	94734	71925	28075	05266	33342	21
40	9.66682	9.94727	9.71955	10.28045	10.05273	10.33318	20
41	66706	94720	71986	28014	05280	33294	19
42	66731	94714	72017	27983	05286	33269	18
43	66755	94707	72048	27952	05293	33245	17
44	66779	94700	72078	27922	05300	33221	16
45	66803	94694	72109	27891	05306	33197	15
46	66827	94687	72140	27860	05313	33173	14
47	66851	94680	72170	27830	05320	33149	13
48	66875	94674	72201	27799	05326	33125	12
49	66899	94667	72231	27769	05333	33101	11
50	9.66922	9.94660	9.72262	10.27738	10.05340	10.33078	10
51	66946	94654	72293	27707	05346	33054	9
52	66970	94647	72323	27677	05353	33030	8
53	66994	94640	72354	27646	05360	33006	7
54	67018	94634	72384	27616	05366	32982	6
55	67042	94627	72415	27585	05373	32958	5
56	67066	94620	72445	27555	05380	32934	4
57	67090	94614	72476	27524	05386	32910	3
58	67113	94607	72506	27494	05393	32887	2
59	67137	94600	72537	27463	05400	32863	1
60	67161	94593	72567	27433	05407	32839	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.67161	9.94593	9.72567	10.27433	10.05407	10.32839	60
1	67185	94587	72598	27402	05413	32815	59
2	67208	94580	72628	27372	05420	32792	58
3	67232	94573	72659	27341	05427	32768	57
4	67256	94567	72689	27311	05433	32744	56
5	67280	94560	72720	27280	05440	32720	55
6	67303	94553	72750	27250	05447	32697	54
7	67327	94546	72780	27220	05454	32673	53
8	67350	94540	72811	27189	05460	32650	52
9	67374	94533	72841	27159	05467	32626	51
10	9.67398	9.94526	9.72872	10.27128	10.05474	10.32602	50
11	67421	94519	72902	27098	05481	32579	49
12	67445	94513	72932	27068	05487	32555	48
13	67468	94506	72963	27037	05494	32532	47
14	67492	94499	72993	27007	05501	32508	46
15	67515	94492	73023	26977	05508	32485	45
16	67539	94485	73054	26946	05515	32461	44
17	67562	94479	73084	26916	05521	32438	43
18	67586	94472	73114	26886	05528	32414	42
19	67609	94465	73144	26856	05535	32391	41
20	9.67633	9.94458	9.73175	10.26825	10.05542	10.32367	40
21	67656	94451	73205	26795	05549	32344	39
22	67680	94445	73235	26765	05555	32320	38
23	67703	94438	73265	26735	05562	32297	37
24	67726	94431	73295	26705	05569	32274	36
25	67750	94424	73326	26674	05576	32250	35
26	67773	94417	73356	26644	05583	32227	34
27	67796	94410	73386	26614	05590	32204	33
28	67820	94404	73416	26584	05596	32180	32
29	67843	94397	73446	26554	05603	32157	31
30	9.67866	9.94390	9.73476	10.26524	10.05610	10.32134	30
31	67890	94383	73507	26493	05617	32110	29
32	67913	94376	73537	26463	05624	32087	28
33	67936	94369	73567	26433	05631	32064	27
34	67959	94362	73597	26403	05638	32041	26
35	67982	94355	73627	26373	05645	32018	25
36	68006	94349	73657	26343	05651	31994	24
37	68029	94342	73687	26313	05658	31971	23
38	68052	94335	73717	26283	05665	31948	22
39	68075	94328	73747	26253	05672	31925	21
40	9.68098	9.94321	9.73777	10.26223	10.05679	10.31902	20
41	68121	94314	73807	26193	05686	31879	19
42	68144	94307	73837	26163	05693	31856	18
43	68167	94300	73867	26133	05700	31833	17
44	68190	94293	73897	26103	05707	31810	16
45	68213	94286	73927	26073	05714	31787	15
46	68237	94279	73957	26043	05721	31763	14
47	68260	94273	73987	26013	05727	31740	13
48	68282	94266	74017	25983	05734	31718	12
49	68305	94259	74047	25953	05741	31695	11
50	9.68328	9.94252	9.74077	10.25923	10.05748	10.31672	10
51	68351	94245	74107	25893	05755	31649	9
52	68374	94238	74137	25863	05762	31626	8
53	68397	94231	74166	25834	05769	31603	7
54	68420	94224	74196	25804	05776	31580	6
55	68443	94217	74226	25774	05783	31557	5
56	68466	94210	74256	25744	05790	31534	4
57	68489	94203	74286	25714	05797	31511	3
58	68512	94196	74316	25684	05804	31488	2
59	68534	94189	74345	25655	05811	31466	1
60	68557	94182	74375	25625	05818	31443	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine	Tangent	Co-tang.	Secant.	Co-secant.	
0	9.68557	9.94182	9.74375	10.25625	10.05818	10.31443	60
1	68580	94175	74405	25595	05825	31420	59
2	68603	94168	74435	25565	05832	31397	58
3	68625	94161	74465	25535	05839	31375	57
4	68648	94154	74494	25506	05846	31352	56
5	68671	94147	74524	25476	05853	31329	55
6	68694	94140	74554	25446	05860	31306	54
7	68716	94133	74583	25417	05867	31284	53
8	68739	94126	74613	25387	05874	31261	52
9	68762	94119	74643	25357	05881	31238	51
10	9.68784	9.94112	9.74673	10.25327	10.05888	10.31216	50
11	68807	94105	74702	25298	05895	31193	49
12	68829	94098	74732	25268	05902	31171	48
13	68852	94090	74762	25238	05910	31148	47
14	68875	94083	74791	25209	05917	31125	46
15	68897	94076	74821	25179	05924	31103	45
16	68920	94069	74851	25149	05931	31080	44
17	68942	94062	74880	25120	05938	31058	43
18	68965	94055	74910	25090	05945	31035	42
19	68987	94048	74939	25061	05952	31013	41
20	9.69010	9.94041	9.74969	10.25031	10.05959	10.30990	40
21	69032	94034	74998	25002	05966	30968	39
22	69055	94027	75028	24972	05973	30945	38
23	69077	94020	75058	24942	05980	30923	37
24	69100	94012	75087	24913	05988	30900	36
25	69122	94005	75117	24883	05995	30878	35
26	69144	93998	75146	24854	06002	30856	34
27	69167	93991	75176	24824	06009	30833	33
28	69189	93984	75205	24795	06016	30811	32
29	69212	93977	75235	24765	06023	30788	31
30	9.69234	9.93970	9.75264	10.24736	10.06030	10.30766	30
31	69256	93963	75294	24706	06037	30744	29
32	69279	93955	75323	24677	06045	30721	28
33	69301	93948	75353	24647	06052	30699	27
34	69323	93941	75382	24618	06059	30677	26
35	69345	93934	75411	24589	06066	30655	25
36	69368	93927	75441	24559	06073	30632	24
37	69390	93920	75470	24530	06080	30610	23
38	69412	93912	75500	24500	06088	30588	22
39	69434	93905	75529	24471	06095	30566	21
40	9.69456	9.93898	9.75558	10.24442	10.06102	10.30544	20
41	69479	93891	75588	24412	06109	30521	19
42	69501	93884	75617	24383	06116	30499	18
43	69523	93876	75647	24353	06124	30477	17
44	69545	93869	75676	24324	06131	30455	16
45	69567	93862	75705	24295	06138	30433	15
46	69589	93855	75735	24265	06145	30411	14
47	69611	93847	75764	24236	06153	30389	13
48	69633	93840	75793	24207	06160	30367	12
49	69655	93833	75822	24178	06167	30345	11
50	9.69677	9.93826	9.75852	10.24148	10.06174	10.30323	10
51	69699	93819	75881	24119	06181	30301	9
52	69721	93811	75910	24090	06189	30279	8
53	69743	93804	75939	24061	06196	30257	7
54	69765	93797	75969	24031	06203	30235	6
55	69787	93789	75998	24002	06211	30213	5
56	69809	93782	76027	23973	06218	30191	4
57	69831	93775	76056	23944	06225	30169	3
58	69853	93768	76086	23914	06232	30147	2
59	69875	93760	76115	23885	06240	30125	1
60	69897	93753	76144	23856	06247	30103	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	
9.93753	9.76144	10.23856	10.06247	10.30103	60
93746	76173	23827	06254	30081	59
93738	76202	23798	06262	30059	58
93731	76231	23769	06269	30037	57
93724	76261	23739	06276	30016	56
93717	76290	23710	06283	29994	55
93709	76319	23681	06291	29972	54
93702	76348	23652	06298	29950	53
93695	76377	23623	06305	29928	52
93687	76406	23594	06313	29907	51
9.93680	9.76435	10.23565	10.06320	10.29885	50
93673	76464	23536	06327	29863	49
93665	76493	23507	06335	29841	48
93658	76522	23478	06342	29820	47
93650	76551	23449	06350	29798	46
93643	76580	23420	06357	29776	45
93636	76609	23391	06364	29755	44
93628	76639	23361	06372	29733	43
93621	76668	23332	06379	29712	42
93614	76697	23303	06386	29690	41
9.93606	9.76725	10.23275	10.06394	10.29668	40
93599	76754	23246	06401	29647	39
93591	76783	23217	06409	29625	38
93584	76812	23188	06416	29604	37
93577	76841	23159	06423	29582	36
93569	76870	23130	06431	29561	35
93562	76899	23101	06438	29539	34
93554	76928	23072	06446	29518	33
93547	76957	23043	06453	29496	32
93539	76986	23014	06461	29475	31
9.93532	9.77015	10.22985	10.06468	10.29453	30
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.71184	9.93307	9.77877	10.22123	10.06693	10.28816	60
1	71205	93299	77906	22094	06701	28795	59
2	71226	93291	77935	22065	06709	28774	58
3	71247	93284	77963	22037	06716	28753	57
4	71268	93276	77992	22008	06724	28732	56
5	71289	93269	78020	21980	06731	28711	55
6	71310	93261	78049	21951	06739	28690	54
7	71331	93253	78077	21923	06747	28669	53
8	71352	93246	78106	21894	06754	28648	52
9	71373	93238	78135	21865	06762	28627	51
10	9.71393	9.93230	9.78163	10.21837	10.06770	10.28607	50
11	71414	93223	78192	21808	06777	28586	49
12	71435	93215	78220	21780	06785	28565	48
13	71456	93207	78249	21751	06793	28544	47
14	71477	93200	78277	21723	06800	28523	46
15	71498	93192	78306	21694	06808	28502	45
16	71519	93184	78334	21666	06816	28481	44
17	71539	93177	78363	21637	06823	28461	43
18	71560	93169	78391	21609	06831	28440	42
19	71581	93161	78419	21581	06839	28419	41
20	9.71602	9.93154	9.78448	10.21552	10.06846	10.28398	40
21	71622	93146	78476	21524	06854	28378	39
22	71643	93138	78505	21495	06862	28357	38
23	71664	93131	78533	21467	06869	28336	37
24	71685	93123	78562	21438	06877	28315	36
25	71705	93115	78590	21410	06885	28295	35
26	71726	93108	78618	21382	06892	28274	34
27	71747	93100	78647	21353	06900	28253	33
28	71767	93092	78675	21325	06908	28233	32
29	71788	93084	78704	21296	06916	28222	31
30	9.71809	9.93077	9.78732	10.21268	10.06923	10.28191	30
31	71829	93069	78760	21240	06931	28171	29
32	71850	93061	78789	21211	06939	28150	28
33	71870	93053	78817	21183	06947	28130	27
34	71891	93046	78845	21155	06954	28109	26
35	71911	93038	78874	21126	06962	28089	25
36	71932	93030	78902	21098	06970	28068	24
37	71952	93022	78930	21070	06978	28048	23
38	71973	93014	78959	21041	06986	28027	22
39	71994	93007	78987	21013	06993	28006	21
40	9.72014	9.92999	9.79015	10.20985	10.07001	10.27986	20
41	72034	92991	79043	20957	07009	27966	19
42	72055	92983	79072	20928	07017	27945	18
43	72075	92976	79100	20900	07024	27925	17
44	72096	92968	79128	20872	07032	27904	16
45	72116	92960	79156	20844	07040	27884	15
46	72137	92952	79185	20815	07048	27863	14
47	72157	92944	79213	20787	07056	27843	13
48	72177	92936	79241	20759	07064	27823	12
49	72198	92929	79269	20731	07071	27802	11
50	9.72218	9.92921	9.79297	10.20703	10.07079	10.27782	10
51	72238	92913	79326	20674	07087	27762	9
52	72259	92905	79354	20646	07095	27741	8
53	72279	92897	79382	20618	07103	27721	7
54	72299	92889	79410	20590	07111	27701	6
55	72320	92881	79438	20562	07119	27680	5
56	72340	92874	79466	20534	07126	27660	4
57	72360	92866	79495	20505	07134	27640	3
58	72381	92858	79523	20447	07142	27619	2
59	72401	92850	79551	20449	07150	27599	1
60	72421	92842	79579	20421	07158	27579	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
9.92842	9.79579	10.20421	10.07158	10.27579	60
92834	79607	20393	07166	27559	59
92826	79635	20365	07174	27539	58
92818	79663	20337	07182	27518	57
92810	79691	20309	07190	37498	56
92803	79719	20281	07197	27478	55
92795	79747	20253	07205	27458	54
92787	79776	20224	07213	27438	53
92779	79804	20196	07221	27418	52
92771	79832	20168	07229	27398	51
9.92763	9.79860	10.20140	10.07237	10.27378	50
92755	79888	20112	07245	27357	49
92747	79916	20084	07253	27337	48
92739	79944	20056	07261	27317	47
92731	79972	20028	07269	27297	46
92723	80000	20000	07277	27277	45
92715	80028	19972	07285	27257	44
92707	80056	19944	07293	27237	43
92699	80084	19916	07301	27217	42
92691	80112	19888	07309	27197	41
9.92683	9.80140	10.19860	10.07317	10.27177	40
92675	80168	19832	07325	27157	39
92667	80195	19805	07333	27137	38
92659	80223	19777	07341	27117	37
92651	80251	19749	07349	27098	36
92643	80279	19721	07357	27078	35
92635	80307	19693	07365	27058	34
92627	80335	19665	07373	27038	33
92619	80363	19637	07381	27018	32
92611	80391	19609	07389	26998	31
9.92603	9.80419	10.19581	10.07397	10.26978	30
92595	80447	19553	07405	26959	29
92587	80474	19526	07413	26939	28

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.73611	9.92359	9.81252	10.18748	10.07641	10.26389	60
1	73630	92351	81279	18721	07649	26370	59
2	73650	92343	81307	18693	07657	26350	58
3	73669	92334	81335	18665	07666	26331	57
4	73689	92326	81362	18638	07674	26311	56
5	73708	92318	81390	18610	07682	26292	55
6	73727	92310	81418	18582	07690	26273	54
7	73747	92302	81445	18555	07698	26253	53
8	73766	92293	81473	18527	07707	26234	52
9	73785	92285	81500	18500	07715	26215	51
10	9.73805	9.92277	9.81528	10.18472	10.07723	10.26195	50
11	73824	92269	81556	18444	07731	26176	49
12	73843	92260	81583	18417	07740	26157	48
13	73863	92252	81611	18389	07748	26137	47
14	73882	92244	81638	18362	07756	26118	46
15	73901	92235	81666	18334	07765	26099	45
16	73921	92227	81693	18307	07773	26079	44
17	73940	92219	81721	18279	07781	26060	43
18	73959	92211	81748	18252	07789	26041	42
19	73978	92202	81776	18224	07798	26022	41
20	9.73997	9.92194	9.81803	10.18197	10.07806	10.26003	40
21	74017	92186	81831	18169	07814	25983	39
22	74036	92177	81858	18142	07823	25964	38
23	74055	92169	81886	18114	07831	25945	37
24	74074	92161	81913	18087	07839	25926	36
25	74093	92152	81941	18059	07848	25907	35
26	74113	92144	81968	18032	07856	25887	34
27	74132	92136	81996	18004	07864	25868	33
28	74151	92127	82023	17977	07873	25849	32
29	74170	92119	82051	17949	07881	25830	31
30	9.74189	9.92111	9.82078	10.17922	10.07889	10.25811	30
31	74208	92102	82106	17894	07898	25792	29
32	74227	93094	82133	17867	07906	25773	28
33	74246	92086	82161	17839	07914	25754	27
34	74265	92077	82188	17812	07923	25735	26
35	74284	92069	82215	17785	07931	25716	25
36	74303	92060	82243	17757	07940	25697	24
37	74322	92052	82270	17730	07948	25678	23
38	74341	92044	82298	17702	07956	25659	22
39	74360	92035	82325	17675	07965	25640	21
40	9.74379	9.92027	9.82352	10.17648	10.07973	10.25621	20
41	74398	92018	82380	17620	07982	25602	19
42	74417	92010	82407	17593	07990	25583	18
43	74436	92002	82435	17565	07998	25564	17
44	74455	91993	82462	17538	08007	25545	16
45	74474	91985	82489	17511	08015	25526	15
46	74493	91976	82517	17483	08024	25507	14
47	74512	91968	82544	17456	08032	25488	13
48	74531	91959	82571	17429	08041	25469	12
49	74549	91951	82599	17401	08049	25451	11
50	9.74568	9.91942	9.82626	10.17374	10.08058	10.25432	10
51	74587	91934	82653	17347	08066	25413	9
52	74606	91925	82681	17319	08075	25394	8
53	74625	91917	82708	17292	08083	25375	7
54	74644	91908	82735	17265	08092	25356	6
55	74662	91900	82762	17238	08100	25338	5
56	74681	91891	82790	17210	08109	25319	4
57	74700	91883	82817	17183	08117	25300	3
58	74719	91874	82844	17156	08126	25281	2
59	74737	91866	82871	17129	08134	25263	1
60	74756	91857	82899	17101	08143	25244	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
9.91857	9.82899	10.17101	10.08143	10.25244	60
91849	82926	17074	08151	25225	59
91840	82953	17047	08160	25206	58
91832	82980	17020	08168	25188	57
91823	83008	16992	08177	25169	56
91815	83035	16965	08185	25150	55
91806	83062	16938	08194	25132	54
91798	83089	16911	08202	25113	53
91789	83117	16883	08211	25094	52
91781	83144	16856	08219	25076	51
9.91772	9.83171	10.16829	10.08228	10.25057	50
91763	83198	16802	08237	25039	49
91755	83225	16775	08245	25020	48
91746	83252	16748	08254	25001	47
91738	83280	16720	08262	24983	46
91729	83307	16693	08271	24964	45
91720	83334	16666	08280	24946	44
91712	83361	16639	08288	24927	43
91703	83388	16612	08297	24909	42
91695	83415	16585	08305	24890	41
9.91686	9.83442	10.16558	10.08314	10.24872	40
91677	83470	16530	08323	24853	39
91669	83497	16503	08331	24835	38
91660	83524	16476	08340	24816	37
91651	83551	16449	08349	24798	36
91643	83578	16422	08357	24779	35
91634	83605	16395	08366	24761	34
91625	83632	16368	08375	24742	33
91617	83659	16341	08383	24724	32
91608	83686	16314	08392	24706	31
9.91599	9.83713	10.16287	10.08401	10.24687	30

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.75859	9.91336	9.84523	10.15477	10.08664	10.24141	60
1	75877	91328	84550	15450	08672	24123	59
2	75895	91319	84576	15424	08681	24105	58
3	75913	91310	84603	15397	08690	24087	57
4	75931	91301	84630	15370	08699	24069	56
5	75949	91292	84657	15343	08708	24051	55
6	75967	91283	24684	15316	08717	24033	54
7	75985	91274	84711	15289	08726	24015	53
8	76003	91266	84738	15262	08734	23997	52
9	76021	91257	84764	15236	08743	23979	51
10	9.76039	9.91248	9.84791	10.15209	10.08752	10.23961	50
11	76057	91239	84818	15182	08761	23943	49
12	76075	91230	84845	15155	08770	23925	48
13	76093	91221	84872	15128	08779	23907	47
14	76111	91212	84899	15101	08788	23889	46
15	76129	91203	84925	15075	08797	23871	45
16	76146	91194	84952	15048	08806	23854	44
17	76164	91185	84979	15021	08815	23836	43
18	76182	91176	85006	14994	08824	23818	42
19	76200	91167	85033	14967	08833	23800	41
20	9.76218	9.91158	9.85059	10.14941	10.08842	10.23782	40
21	76236	91149	85086	14914	08851	23764	39
22	76253	91141	85113	14887	08859	23747	38
23	76271	91132	85140	14860	08868	23729	37
24	76289	91123	85166	14834	08877	23711	36
25	76307	91114	85193	14807	08886	23693	35
26	76324	91105	85220	14780	08895	23676	34
27	76342	91096	85247	14753	08904	23658	33
28	76360	91087	85273	14727	08913	23640	32
29	76378	91078	85300	14700	08922	23622	31
30	9.76395	9.91069	9.85327	10.14673	10.08931	10.23605	30
31	76413	91060	85354	14646	08940	23587	29
32	76431	91051	85380	14620	08949	23569	28
33	76448	91042	85407	14593	08958	23552	27
34	76466	91033	85434	14566	08967	23534	26
35	76484	91023	85460	14540	08977	23516	25
36	76501	91014	85487	14513	08986	23499	24
37	76519	91005	85514	14486	08995	23481	23
38	76537	90996	85540	14460	09004	23463	22
39	76554	90987	85567	14433	09013	23446	21
40	9.76572	9.90978	9.85594	10.14406	10.09022	10.23428	20
41	76590	90969	85620	14380	09031	23410	19
42	76607	90960	85647	14353	09040	23393	18
43	76625	90951	85674	14326	09049	23375	17
44	76642	90942	85700	14300	09058	23358	16
45	76660	90933	85727	14273	09067	23340	15
46	76677	90924	85754	14246	09076	23323	14
47	76695	90915	85780	14220	09085	23305	13
48	76712	90906	85807	14193	09094	23288	12
49	76730	90896	85834	14166	09104	23270	11
50	9.76747	9.90887	9.85860	10.14140	10.09113	10.23253	10
51	76765	90878	85287	14113	09122	23235	9
52	76782	90869	85913	14087	09131	23218	8
53	76800	90860	25940	14060	09140	23200	7
54	76817	90851	85967	14033	09149	23183	6
55	76835	90842	85993	14007	09158	23165	5
56	76852	90832	86020	13980	09168	23148	4
57	76870	90823	86046	13954	09177	23130	3
58	76887	90814	86073	13927	09186	23113	2
59	76904	90805	26100	13900	09195	23096	1
60	76922	90796	26126	13874	09204	23078	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.76922	9.90796	9.86126	10.13874	10.09204	10.23078	60
1	76939	90787	86153	13847	09213	23061	59
2	76957	90777	86179	13821	09223	23043	58
3	76974	90768	86206	13794	09232	23026	57
4	76991	90759	86232	13768	09241	23009	56
5	77009	90750	86259	13741	09250	22991	55
6	77026	90741	86285	13715	09259	22974	54
7	77043	90731	86312	13688	09269	22957	53
8	77061	90722	86338	13662	09278	22939	52
9	77078	90713	86365	13635	09287	22922	51
10	9.77095	9.90704	9.86392	10.13608	10.09296	10.22905	50
11	77112	90694	86418	13582	09306	22888	49
12	77130	90685	86445	13555	09315	22870	48
13	77147	90676	86471	13529	09324	22853	47
14	77164	90667	86498	13502	09333	22836	46
15	77181	90657	86524	13476	09343	22819	45
16	77199	90648	86551	13449	09352	22801	44
17	77216	90639	86577	13423	09361	22784	43
18	77233	90630	86603	13397	09370	22767	42
19	77250	90620	86630	13370	09380	22750	41
20	9.77268	9.90611	9.86656	10.13344	10.09389	10.22732	40
21	77285	90602	86683	13317	09398	22715	39
22	77302	90592	86709	13291	09408	22698	38
23	77319	90583	86736	13264	09417	22681	37
24	77336	90574	86762	13238	09426	22664	36
25	77353	90565	86789	13211	09435	22647	35
26	77370	90555	86815	13185	09445	22630	34
27	77387	90546	86842	13158	09454	22613	33
28	77405	90537	86868	13132	09463	22595	32
29	77422	90527	86894	13106	09473	22578	31
30	9.77439	9.90518	9.86921	10.13079	10.09482	10.22561	30
31	77456	90509	86947	13053	09491	22544	29
32	77473	90499	86974	13026	09501	22527	28
33	77490	90490	87000	13000	09510	22510	27
34	77507	90480	87027	12973	09520	22493	26
35	77524	90471	87053	12947	09529	22476	25
36	77541	90462	87079	12921	09538	22459	24
37	77558	90452	87106	12894	09548	22442	23
38	77575	90443	87132	12868	09557	22425	22
39	77592	90434	87158	12842	09566	22408	21
40	9.77609	9.90424	9.87185	10.12815	10.09576	10.22391	20
41	77626	90415	87211	12789	09585	22374	19
42	77643	90405	87238	12762	09595	22357	18
43	77660	90396	87264	12736	09604	22340	17
44	77677	90386	87290	12710	09614	22323	16
45	77694	90377	87317	12683	09623	22306	15
46	77711	90368	87343	12657	09632	22289	14
47	77727	90358	87369	12631	09642	22273	13
48	77744	90349	87396	12604	09651	22256	12
49	77761	90339	87422	12578	09661	22239	11
50	9.77778	9.90330	9.87448	10.12552	10.09670	10.22222	10
51	77795	90320	87475	12525	09680	22205	9
52	77812	90311	87501	12499	09689	22188	8
53	77829	90301	87527	12473	09699	22171	7
54	77846	90292	87554	12446	09708	22154	6
55	77862	90282	87580	12420	09718	22138	5
56	77879	90273	87606	12394	09727	22121	4
57	77896	90263	87633	12367	09737	22104	3
58	77913	90254	87659	12341	09746	22087	2
59	77930	90244	87685	12315	09756	22070	1
60	77946	90235	87711	12289	09765	22054	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.77946	9.90235	9.87711	10.12289	10.09765	10.22054	60
1	77963	90225	87738	12262	09775	22037	59
2	77980	90216	87764	12236	09784	22020	58
3	77997	90206	87790	12210	09794	22003	57
4	78013	90197	87817	12183	09803	21987	56
5	78030	90187	87843	12157	09813	21970	55
6	78047	90178	87869	12131	09822	21953	54
7	78063	90168	87895	12105	09832	21937	53
8	78080	90159	87922	12078	09841	21920	52
9	78097	90149	87948	12052	09851	21903	51
10	9.78113	9.90139	9.87974	10.12026	10.09861	10.21887	50
11	78130	90130	88000	12000	09870	21870	49
12	78147	90120	88027	11973	09880	21853	48
13	78163	90111	88053	11947	09889	21837	47
14	78180	90101	88079	11921	09899	21820	46
15	78197	90091	88105	11895	09909	21803	45
16	78213	90082	88131	11869	09918	21787	44
17	78230	90072	88158	11842	09928	21770	43
18	78246	90063	88184	11816	09937	21754	42
19	78263	90053	88210	11790	09947	21737	41
20	9.78280	9.90043	9.88236	10.11764	10.09957	10.21720	40
21	78296	90034	88262	11738	09966	21704	39
22	78313	90024	88289	11711	09976	21687	38
23	78329	90014	88315	11685	09986	21671	37
24	78346	90005	88341	11659	09995	21654	36
25	78362	89995	88367	11633	10005	21638	35
26	78379	89985	88393	11607	10015	21621	34
27	78395	89976	88420	11580	10024	21605	33
28	78412	89966	88446	11554	10034	21588	32
29	78428	89956	88472	11528	10044	21572	31
30	9.78445	9.89947	9.88498	10.11502	10.10053	10.21555	30
31	78461	89937	88524	11476	10063	21539	29
32	78478	89927	88550	11450	10073	21522	28
33	78494	89918	88577	11423	10082	21506	27
34	78510	89908	88603	11397	10092	21490	26
35	78527	89898	88629	11371	10102	21473	25
36	78543	89888	88655	11345	10112	21457	24
37	78560	89879	88681	11319	10121	21440	23
38	78576	89869	88707	11293	10131	21424	22
39	78592	89859	88733	11267	10141	21408	21
40	9.78609	9.89849	9.88759	10.11241	10.10151	10.21391	20
41	78625	89840	88786	11214	10160	21375	19
42	78642	89830	88812	11188	10170	21358	18
43	78658	89820	88838	11162	10180	21342	17
44	78674	89810	88864	11136	10190	21326	16
45	78691	89801	88890	11110	10199	21309	15
46	78707	89791	88916	11084	10209	21293	14
47	78723	89781	88942	11058	10219	21277	13
48	78739	89771	88968	11032	10229	21261	12
49	78756	89761	88994	11006	10239	21244	11
50	9.78772	9.89752	9.89020	10.10980	10.10248	10.21228	10
51	78788	89742	89046	10954	10258	21212	9
52	78805	89732	89073	10927	10268	21195	8
53	78821	89722	89099	10901	10278	21179	7
54	78837	89712	89125	10875	10288	21163	6
55	78853	89702	89151	10849	10298	21147	5
56	78869	89693	89177	10823	10307	21131	4
57	78886	89683	89203	10797	10317	21114	3
58	78902	89673	89229	10771	10327	21098	2
59	78918	89663	89255	10745	10337	21082	1
60	78934	89653	89281	10719	10347	21066	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

TABLE V. OF ARTIFICIAL SINES, TANGENTS, AND SECANTS. 38 DEGS.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.78934	9.89653	9.89281	10.10719	10.10347	10.21066	60
1	78950	89643	89307	10693	10357	21050	59
2	78967	89633	89333	10667	10367	21033	58
3	78983	89624	89359	10641	10376	21017	57
4	78999	89614	89385	10615	10386	21001	56
5	79015	89604	89411	10589	10396	20985	55
6	79031	89594	89437	10563	10406	20969	54
7	79047	89584	89463	10537	10416	20953	53
8	79063	89574	89489	10511	10426	20937	52
9	79079	89564	89515	10485	10436	20921	51
10	9.79095	9.89554	9.89541	10.10459	10.10446	10.20905	50
11	79111	89544	89567	10433	10456	20889	49
12	79128	89534	89593	10407	10466	20872	48
13	79144	89524	89619	10381	10476	20856	47
14	79160	89514	89645	10355	10486	20840	46
15	79176	89504	89671	10329	10496	20824	45
16	79192	89495	89697	10303	10505	20808	44
17	79208	89485	89723	10277	10515	20792	43
18	79224	89475	89749	10251	10525	20776	42
19	79240	89465	89775	10225	10535	20760	41
20	9.79256	9.89455	9.89801	10.10199	10.10545	10.20744	40
21	79272	89445	89827	10173	10555	20728	39
22	79288	89435	89853	10147	10565	20712	38
23	79304	89425	89879	10121	10575	20696	37
24	79319	89415	89905	10095	10585	20681	36
25	79335	89405	89931	10069	10595	20665	35
26	79351	89395	89957	10043	10605	20649	34
27	79367	89385	89983	10017	10615	20633	33
28	79383	89375	90009	09991	10625	20617	32
29	79399	89364	90035	09965	10636	20601	31
30	9.79415	9.89354	9.90061	10.09939	10.10646	10.20585	30
31	79431	89344	90086	09914	10656	20569	29
32	79447	89334	90112	09888	10666	20553	28
33	79463	89324	90138	09862	10676	20537	27
34	79478	89314	90164	09836	10686	20522	26
35	79494	89304	90190	09810	10696	20506	25
36	79510	89294	90216	09784	10706	20490	24
37	79526	89284	90242	09758	10716	20474	23
38	79542	89274	90268	09732	10726	20458	22
39	79558	89264	90294	09706	10736	20442	21
40	9.79573	9.89254	9.90320	10.09680	10.10746	10.20427	20
41	79589	89244	90346	09654	10756	20411	19
42	79605	89233	90371	09629	10767	20395	18
43	79621	89223	90397	09603	10777	20379	17
44	79636	89213	90423	09577	10787	20364	16
45	79652	89203	90449	09551	10797	20348	15
46	79668	89193	90475	09525	10807	20332	14
47	79684	89183	90501	09499	10817	20316	13
48	79699	89173	90527	09473	10827	20301	12
49	79715	89162	90553	09447	10838	20285	11
50	9.79731	9.89152	9.96578	10.09422	10.10848	10.20269	10
51	79746	89142	90604	09396	10858	20254	9
52	79762	89132	90630	09370	10868	20238	8
53	79778	89122	90656	09344	10878	20222	7
54	79793	89112	90682	09318	10888	20207	6
55	79809	89101	90708	09292	10899	20191	5
56	79825	89091	90734	09266	10909	20175	4
57	79840	89081	90759	09241	10919	20160	3
58	79856	89071	90785	09215	10929	20144	2
59	79872	89060	90811	09189	10940	20128	1
60	79887	89050	90837	09163	10950	20113	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

51 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.79887	9.89050	9.90837	10.09163	10.10950	10.20113	60
1	79903	89040	90863	09137	10960	20097	59
2	79918	89030	90889	09111	10970	20082	58
3	79934	89020	90914	09086	10980	20066	57
4	79950	89009	90940	09060	10991	20050	56
5	79965	88999	90966	09034	11001	20035	55
6	79981	88989	90992	09008	11011	20019	54
7	79996	88978	91018	08982	11022	20004	53
8	80012	88968	91043	08957	11032	19988	52
9	80027	88958	91069	08931	11042	19973	51
10	9.80043	9.88948	9.91095	10.08905	10.11052	10.19957	50
11	80058	88937	91121	08879	11063	19942	49
12	80074	88927	91147	08853	11073	19926	48
13	80089	88917	91172	08828	11083	19911	47
14	80105	88906	91198	08802	11094	19895	46
15	80120	88896	91224	08776	11104	19880	45
16	80136	88886	91250	08750	11114	19864	44
17	80151	88275	91276	08724	11125	19849	43
18	80166	88865	91301	08699	11135	19834	42
19	80182	82855	91327	08673	11145	19818	41
20	9.80197	9.88844	9.91353	10.08647	10.11156	10.19803	40
21	80213	88834	91379	08621	11166	19787	39
22	80228	88824	91404	08596	11176	19772	38
23	80244	88813	91430	08570	11187	19756	37
24	80259	88803	91456	08544	11197	19741	36
25	80274	88793	91482	08518	11207	19726	35
26	80290	88782	91507	08493	11218	19710	34
27	80305	88772	91533	08467	11228	19695	33
28	80320	88761	91559	08441	11239	19680	32
29	80336	88751	91585	08415	11249	19664	31
30	9.80351	9.88741	9.91610	10.08390	10.11259	10.19649	30
31	80366	88730	91636	08364	11270	19634	29
32	80382	88820	91662	08338	11280	19618	28
33	80397	88709	91688	08312	11291	19603	27
34	80412	88699	91713	08287	11301	19588	26
35	80428	88628	91739	08261	11312	19572	25
36	80443	88678	91765	08235	11322	19557	24
37	80458	88668	91791	08209	11332	19542	23
38	80473	88657	91816	08184	11348	19527	22
39	80489	88647	91842	08158	11353	19511	21
40	9.80504	9.88636	9.91868	10.08132	10.11364	10.19496	20
41	80519	88626	91893	08107	11374	19481	19
42	80534	88615	91919	08081	11385	19466	18
43	80550	88605	91945	08055	11395	19450	17
44	80565	88594	91971	08029	11406	19435	16
45	80580	88584	91996	08004	11416	19420	15
46	80595	88573	92022	07978	11427	19405	14
47	80610	88563	92048	07952	11437	19390	13
48	80625	88552	92073	07927	11448	19375	12
49	80641	88542	92099	07901	11458	19359	11
50	9.80656	9.88531	9.92125	10.07875	10.11469	10.19344	10
51	80671	88521	92150	07850	11479	19329	9
52	80686	88510	92176	07824	11490	19314	8
53	80701	88499	92202	07798	11501	19299	7
54	80716	88489	92227	07773	11511	19284	6
55	80731	88478	92253	07747	11522	19269	5
56	80746	88468	92279	07721	11532	19254	4
57	80762	88457	92304	07696	11543	19238	3
58	80777	88447	92330	07670	11553	19223	2
59	80792	88436	92356	07644	11564	19208	1
60	80807	88425	92381	07619	11575	19193	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.80807	9.88425	9.92381	10.07619	10.11575	10.19193	60
1	80822	88415	92407	07593	11585	19178	59
2	80837	88404	92433	07567	11596	19163	58
3	80852	88394	92458	07542	11606	19148	57
4	80867	88383	92484	07516	11617	19133	56
5	80882	88372	92510	07490	11628	19118	55
6	80897	88362	92535	07465	11638	19103	54
7	80912	88351	92561	07439	11649	19088	53
8	80927	88340	92587	07413	11660	19073	52
9	80942	88330	92612	07388	11670	19058	51
10	9.80957	9.88319	9.92638	10.07362	10.11681	10.19043	50
11	80972	88308	92663	07337	11692	19028	49
12	80987	88298	92689	07311	11702	19013	48
13	81002	88287	92715	07285	11713	18998	47
14	81017	88276	92740	07260	11724	18983	46
15	81032	88266	92766	07234	11734	18968	45
16	81047	88255	92792	07208	11745	18954	44
17	81061	88244	92817	07183	11756	18939	43
18	81076	88234	92843	07157	11766	18924	42
19	81091	88223	92868	07132	11777	18909	41
20	9.81106	9.88212	9.92894	10.07106	10.11788	10.18894	40
21	81121	88201	92920	07080	11799	18879	39
22	81136	88191	92945	07055	11809	18864	38
23	81151	88180	92971	07029	11820	18849	37
24	81166	88169	92996	07004	11831	18834	36
25	81180	88158	93022	06978	11842	18820	35
26	81195	88148	93048	06952	11852	18805	34
27	81210	88137	93073	06927	11863	18790	33
28	81225	88126	93099	06901	11874	18775	32
29	81240	88115	93124	06876	11885	18760	31
30	9.81254	9.88105	9.93150	10.06850	10.11895	10.18746	30
31	81269	88094	93175	06825	11906	18731	29
32	81284	88083	93201	06799	11917	18716	28
33	81299	88072	93227	06773	11928	18701	27
34	81314	88061	93252	06748	11939	18686	26
35	81328	88051	93278	06722	11949	18672	25
36	81343	88040	93303	06697	11960	18657	24
37	81358	88029	93329	06671	11971	18642	23
38	81372	88018	93354	06646	11982	18628	22
39	81387	88007	93380	06620	11993	18613	21
40	9.81402	9.87996	9.93406	10.06594	10.12004	10.18598	20
41	81417	87985	93431	06569	12015	18583	19
42	81431	87975	93457	06543	12025	18569	18
43	81446	87964	93482	06518	12036	18554	17
44	81461	87953	93508	06492	12047	18539	16
45	81475	87942	93533	06467	12058	18525	15
46	81490	87931	93559	06441	12069	18510	14
47	81505	87920	93584	06416	12080	18495	13
48	81519	87909	93610	06390	12091	18481	12
49	81534	87898	93636	06364	12102	18466	11
50	9.81549	9.87887	9.93661	10.06339	10.12113	10.18451	10
51	81563	87877	93687	06313	12123	18437	9
52	81578	87866	93712	06288	12134	18422	8
53	81592	87855	93738	06262	12145	18408	7
54	81607	87844	93763	06237	12156	18393	6
55	81622	87833	93789	06211	12167	18378	5
56	81636	87822	93814	06186	12178	18364	4
57	81651	87811	93840	06160	12189	18349	3
58	81665	87800	93865	06135	12200	18335	2
59	81680	87789	93891	06109	12211	18320	1
60	81694	87778	93916	06084	12222	18306	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.81694	9.87778	9.93916	10.06084	10.12222	10.18306	60
1	81709	87767	93942	06058	12233	18291	59
2	81723	87756	93967	06033	12244	18277	58
3	81738	87745	93993	06007	12255	18262	57
4	81752	87734	94018	05982	12266	18248	56
5	81767	87723	94044	05956	12277	18233	55
6	81781	87712	94069	05931	12288	18219	54
7	81796	87701	94095	05905	12299	18204	53
8	81810	87690	94120	05880	12310	18190	52
9	81825	87679	94146	05854	12321	18175	51
10	9.81839	9.87668	9.94171	10.05829	10.12332	10.18161	50
11	81854	87657	94197	05803	12343	18146	49
12	81868	87646	94222	05778	12354	18132	48
13	81882	87635	94248	05752	12365	18118	47
14	81897	87624	94273	05727	12376	18103	46
15	81911	87613	94299	05701	12387	18089	45
16	81926	87601	94324	05676	12399	18074	44
17	81940	87590	94350	05650	12410	18060	43
18	81955	87579	94375	05625	12421	18045	42
19	81969	87568	94401	05599	12432	18031	41
20	9.81983	9.87557	9.94426	10.05574	10.12443	10.18017	40
21	81998	87546	94452	05548	12454	18002	39
22	82012	87535	94477	05523	12465	17988	38
23	82026	87524	94503	05497	12476	17974	37
24	82041	87513	94528	05472	12487	17959	36
25	82055	87501	94554	05446	12499	17945	35
26	82069	87490	94579	05421	12510	17931	34
27	82084	87479	94604	05396	12521	17916	33
28	82098	87468	94630	05370	12532	17902	32
29	82112	87457	94655	05345	12543	17888	31
30	9.82126	9.87446	9.94681	10.05319	10.12554	10.17874	30
31	82141	87434	94706	05294	12566	17859	29
32	82155	87423	94732	05268	12577	17845	28
33	82169	87412	94757	05243	12588	17831	27
34	82184	87401	94783	05217	12599	17816	26
35	82298	87390	94808	05192	12610	17802	25
36	82212	87378	94834	05166	12622	17788	24
37	82226	87367	94859	05141	12633	17774	23
38	82240	87356	94884	05116	12644	17760	22
39	82255	87345	94910	05090	12655	17745	21
40	9.82269	9.87334	9.94935	10.05065	10.12666	10.17731	20
41	82288	87322	94961	05089	12678	17717	19
42	82297	87311	94986	05014	12689	17703	18
43	82311	87300	95012	04988	12700	17689	17
44	82326	87288	95037	04963	12712	17674	16
45	82340	87277	95062	04938	12723	17660	15
46	82354	87266	95088	04912	12734	17646	14
47	82368	87255	95113	04887	12745	17632	13
48	82382	87243	95139	04861	12757	17618	12
49	82396	87232	95164	04836	12768	17604	11
50	9.82410	9.87221	9.95190	10.04810	10.12779	10.17590	10
51	82424	87209	95215	04785	12791	17576	9
52	82439	87198	95240	04760	12802	17561	8
53	82453	87187	95266	04734	12813	17547	7
54	82467	87175	95291	04709	12825	17533	6
55	82481	87164	95317	04683	12836	17519	5
56	82495	87153	95342	04658	12847	17505	4
57	82509	87141	95368	04632	12859	17491	3
58	82523	87130	95393	04607	12870	17477	2
59	82537	87119	95418	04582	12881	17463	1
60	82551	87107	95444	04556	12893	17449	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.82551	9.87107	9.95444	10.04556	10.12893	10.17449	60
1	82565	87096	95469	04531	12904	17435	59
2	82579	87085	95495	04505	12915	17421	58
3	82593	87073	95520	04480	12927	17407	57
4	82607	87062	95545	04455	12938	17393	56
5	82621	87050	95571	04429	12950	17379	55
6	82635	87039	95596	04404	12961	17365	54
7	82649	87028	95622	04378	12972	17351	53
8	82663	87016	95647	04353	12984	17337	52
9	82677	87005	95672	04328	12995	17323	51
10	9.82691	9.86993	9.95698	10.04302	10.13007	10.17309	50
11	82705	86982	95723	04277	13018	17295	49
12	82719	86970	95748	04252	13030	17281	48
13	82733	86959	95774	04226	13041	17267	47
14	82747	86947	95799	04201	13053	17253	46
15	82761	86936	95825	04175	13064	17239	45
16	82775	86924	95850	04150	13076	17225	44
17	82788	86913	95875	04125	13087	17212	43
18	82802	86902	95901	04099	13098	17198	42
19	82816	86890	95926	04074	13110	17184	41
20	9.82830	9.86879	9.95952	10.04048	10.13121	10.17170	40
21	82844	86867	95977	04023	13133	17156	39
22	82858	86855	96002	03998	13145	17142	38
23	82872	86844	96028	03972	13156	17128	37
24	82885	86832	96053	03947	13168	17115	36
25	82899	86821	96078	03922	13179	17101	35
26	82913	86809	96104	03896	13191	17087	34
27	82927	86798	96129	03871	13202	17073	33
28	82941	86786	96155	03845	13214	17059	32
29	82955	86775	96180	03820	13225	17045	31
30	9.82968	9.86763	9.96205	10.03795	10.13237	10.17032	30
31	82982	86752	96231	03769	13248	17018	29
32	82996	86740	96256	03744	13260	17004	28
33	83010	86728	96281	03719	13272	16990	27
34	83023	86717	96307	03693	13283	16977	26
35	83037	86705	96332	03668	13295	16963	25
36	83051	86694	96357	03643	13306	16949	24
37	83065	86682	96383	03617	13318	16935	23
38	83078	86670	96408	03592	13330	16922	22
39	83092	86659	96433	03567	13341	16908	21
40	9.83106	9.86647	9.96459	10.03541	10.13353	10.16894	20
41	83120	86635	96484	03516	13365	16880	19
42	83133	86624	96510	03490	13376	16867	18
43	83147	86612	96535	03465	13388	16853	17
44	83161	86600	96560	03440	13400	16839	16
45	83174	86589	96586	03414	13411	16826	15
46	83188	86577	96611	03389	13423	16812	14
47	83202	86565	96636	03364	13435	16798	13
48	83215	86554	96662	03338	13446	16785	12
49	83229	86542	96687	03313	13458	16771	11
50	9.83242	9.86530	9.96712	10.03288	10.13470	10.16758	10
51	83256	86518	96738	03262	13482	16744	9
52	83270	86507	96763	03237	13493	16730	8
53	83283	86495	96788	03212	13505	16717	7
54	83297	86483	96814	03186	13517	16703	6
55	83311	86472	96839	03161	13528	16689	5
56	83324	86460	96864	03136	13540	16676	4
57	83338	86448	96890	03110	13552	16662	3
58	83351	86436	96915	03085	13564	16649	2
59	83365	86425	96940	03060	13575	16635	1
60	83378	86413	96966	03034	13587	16622	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.83378	9.86413	9.96966	10.03034	10.13587	10.16622	60
1	83392	86401	96991	03009	13599	16608	59
2	83405	86389	97016	02984	13611	16595	58
3	83419	86377	97042	02958	13623	16581	57
4	83432	86366	97067	02933	13634	16568	56
5	83446	86354	97092	02908	13646	16554	55
6	83459	86342	97118	02882	13658	16541	54
7	83473	86330	97143	02857	13670	16527	53
8	83486	86318	97168	02832	13682	16514	52
9	83500	86306	97193	02807	13694	16500	51
10	9.83513	9.86295	9.97219	10.02781	10.13705	10.16487	50
11	83527	86283	97244	02756	13717	16473	49
12	83540	86271	97269	02731	13729	16460	48
13	83554	86259	97295	02705	13741	16446	47
14	83567	86247	97320	02680	13753	16433	46
15	83581	86235	97345	02655	13765	16419	45
16	83594	86223	97371	02629	13777	16406	44
17	83608	86211	97396	02604	13789	16392	43
18	83621	86200	97421	02579	13800	16379	42
19	83634	86188	97447	02553	13812	16366	41
20	9.83648	9.86176	9.97472	10.02528	10.13824	10.16352	40
21	83661	86164	97497	02503	13836	16339	39
22	83674	86152	97523	02477	13848	16326	38
23	83688	86140	97548	02452	13860	16312	37
24	83701	86128	97573	02427	13872	16299	36
25	83715	86116	97598	02402	13884	16285	35
26	83728	86104	97624	02376	13896	16272	34
27	83741	86092	97649	02351	13908	16259	33
28	83755	86080	97674	02326	13920	16245	32
29	83768	86068	97700	02300	13932	16232	31
30	9.83781	9.86056	9.97725	10.02275	10.13944	10.16219	30
31	83795	86044	97750	02250	13956	16205	29
32	83808	86032	97776	02224	13968	16192	28
33	83821	86020	97801	02199	13980	16179	27
34	83834	86008	97826	02174	13992	16166	26
35	83848	85996	97851	02149	14004	16152	25
36	83861	85984	97877	02123	14016	16139	24
37	83874	85972	97902	02098	14028	16126	23
38	83887	85960	97927	02073	14040	16113	22
39	83901	85948	97953	02047	14052	16099	21
40	9.83914	9.85936	9.97978	10.02022	10.14064	10.16086	20
41	83927	85924	98003	01997	14076	16073	19
42	83940	85912	98029	01971	14088	16060	18
43	83954	85900	98054	01946	14100	16046	17
44	83967	85888	98079	01921	14112	16033	16
45	83980	85876	98104	01896	14124	16020	15
46	83993	85864	98130	01870	14136	16007	14
47	84006	85851	98155	01845	14149	15994	13
48	84020	85839	98180	01820	14161	15980	12
49	84033	85827	98206	01794	14173	15967	11
50	9.84046	9.85815	9.98231	10.01769	10.14185	10.15954	10
51	84059	85803	98256	01744	14197	15941	9
52	84072	85791	98281	01719	14209	15928	8
53	84085	85779	98307	01693	14221	15915	7
54	84099	85766	98332	01668	14234	15901	6
55	84112	85754	98357	01643	14246	15888	5
56	84125	85742	98383	01617	14258	15875	4
57	84138	85730	98408	01592	14270	15862	3
58	84151	85718	98433	01567	14282	15849	2
59	84164	85706	98458	01542	14294	15836	1
60	84177	85693	98484	01516	14307	15823	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
.85693	9.98484	10.01516	10.14307	10.15823	60
85681	98509	01491	14319	15810	59
85669	98534	01466	14331	15797	58
85657	98560	01440	14343	15784	57
85645	98585	01415	14355	15771	56
85632	98610	01390	14368	15758	55
85620	98635	01365	14380	15745	54
85608	98661	01339	14392	15731	53
85596	98686	01314	14404	15718	52
85583	98711	01289	14417	15705	51
.85571	9.98737	10.01263	10.14429	10.15692	50
85559	98762	01238	14441	15679	49
85547	98787	01213	14453	15666	48
85534	98812	01188	14466	15653	47
85522	98838	01162	14478	15640	46
85510	98863	01137	14490	15627	45
85497	98888	01112	14503	15615	44
85785	98913	01087	14515	15602	43
85473	98939	01061	14527	15589	42
85460	98964	01036	14540	15576	41
.85448	9.98989	10.01011	10.14552	10.15563	40
85436	99015	00985	14564	15550	39
85423	99040	00960	14577	15537	38
85411	99065	00935	14589	15524	37
85399	99090	00910	14601	15511	36
85386	99116	00884	14614	15498	35
85374	99141	00859	14626	15485	34
85361	99166	00834	14639	15472	33
85349	99191	00809	14651	15460	32
85337	99217	00783	14663	15447	31
.85324	9.99242	10.00758	10.14676	10.15434	30
85312	99267	00733	14688	15421	29
85299	99293	00707	14701	15408	28

TABLE VI. Meridional Parts.

M.	0d.	1d.	2d.	3d.	4d.	5d.	6d.	7d.	8d.	9d.	10d.	11d.	12d.	13d.	M.
0	0	60	120	180	240	300	361	421	482	542	603	664	725	787	0
1	1	61	121	181	241	301	362	422	483	543	604	665	726	788	1
2	2	62	122	182	242	302	363	423	484	544	605	666	727	789	2
3	3	63	123	183	243	303	364	424	485	545	606	667	728	790	3
4	4	64	124	184	244	304	365	425	486	546	607	668	729	791	4
5	5	65	125	185	245	305	366	426	487	547	608	669	731	792	5
6	6	66	126	186	246	306	367	427	488	548	609	670	732	793	6
7	7	67	127	187	247	307	368	428	489	549	610	671	733	794	7
8	8	68	128	188	248	308	369	429	490	550	611	672	734	795	8
9	9	69	129	189	249	309	370	430	491	551	612	673	735	796	9
10	10	70	130	190	250	310	371	431	492	552	613	674	736	797	10
11	11	71	131	191	251	311	372	432	493	553	614	675	737	798	11
12	12	72	132	192	252	312	373	433	494	554	615	676	738	799	12
13	13	73	133	193	253	313	374	434	495	555	616	677	739	800	13
14	14	74	134	194	254	314	375	435	496	556	617	678	740	801	14
15	15	75	135	195	255	315	376	436	497	557	618	679	741	802	15
16	16	76	136	196	256	316	377	437	498	558	619	680	742	803	16
17	17	77	137	197	257	318	378	438	499	559	620	681	743	804	17
18	18	78	138	198	258	319	379	439	500	561	621	682	744	805	18
19	19	79	139	199	259	320	380	440	501	562	622	683	745	806	19
20	20	80	140	200	260	321	381	441	502	563	623	685	746	807	20
21	21	81	141	201	261	322	382	442	503	564	624	686	747	808	21
22	22	82	142	202	262	323	383	443	504	565	625	687	748	809	22
23	23	83	143	203	263	324	384	444	505	566	626	688	749	810	23
24	24	84	144	204	264	325	385	445	506	567	627	689	750	811	24
25	25	85	145	205	265	326	386	446	507	568	629	690	751	813	25
26	26	86	146	206	266	327	387	447	508	569	630	691	752	814	26
27	27	87	147	207	267	328	388	448	509	570	631	692	753	815	27
28	28	88	148	208	268	329	389	449	510	571	632	693	754	816	28
29	29	89	149	209	269	330	390	450	511	572	633	694	755	817	29
30	30	90	150	210	270	331	391	451	512	573	634	695	756	[illegible]	30
31	31	91	151	211	271	332	392	452	513	574	635	696	757	819	31
32	32	92	152	212	272	333	393	453	514	575	636	697	758	820	32
33	33	93	153	213	273	334	394	454	515	576	637	698	759	821	33
34	34	94	154	214	274	335	395	455	516	577	638	699	760	822	34
35	35	95	155	215	275	336	396	456	517	578	639	700	761	823	35
36	36	96	156	216	276	337	397	457	518	579	640	701	762	824	36
37	37	97	157	217	277	338	398	458	519	580	641	702	763	825	37
38	38	98	158	218	278	339	399	459	520	581	642	703	764	826	38
39	39	99	159	219	279	340	400	460	521	582	643	704	765	827	39
40	40	100	160	220	280	341	401	461	522	583	644	705	766	828	40
41	41	101	161	221	281	342	402	462	523	584	645	706	767	829	41
42	42	102	162	222	282	343	403	463	524	585	646	707	768	830	42
43	43	103	163	223	283	344	404	464	525	586	647	708	769	831	43
44	44	104	164	224	284	345	405	465	526	587	648	709	770	832	44
45	45	105	165	225	285	346	406	466	527	588	649	710	771	833	45
46	46	106	166	226	286	347	407	467	528	589	650	711	772	834	46
47	47	107	167	227	287	348	408	468	529	590	651	712	773	835	47
48	48	108	168	228	288	349	409	470	530	591	652	713	775	836	48
49	49	109	169	229	289	350	410	471	531	592	653	714	776	837	49
50	50	110	170	230	290	351	411	472	532	593	654	715	777	838	50
51	51	111	171	231	291	352	412	473	533	594	655	716	778	839	51
52	52	112	172	232	292	353	413	474	534	595	656	717	779	840	52
53	53	113	173	233	293	354	414	475	535	596	657	718	780	841	53
54	54	114	174	234	294	355	415	476	536	597	658	719	781	842	54
55	55	115	175	235	295	356	416	477	537	598	659	720	782	843	55
56	56	116	176	236	296	357	417	478	538	599	660	721	783	844	56
57	57	117	177	237	297	358	418	479	539	600	661	722	784	845	57
58	58	118	178	238	298	359	419	480	540	601	662	723	785	847	58
59	59	119	179	239	299	360	420	481	541	602	663	724	786	848	59
M.	0d.	1d.	2d.	3d.	4d.	5d.	6d.	7d.	8d.	9d.	10d.	11d.	12d.	13d.	M.

TABLE VI. Meridional Parts.

M.	14d.	15d.	16d.	17d.	18d.	19d.	20d.	21d.	22d.	23d.	24d.	25d.	26d.	27d.	M.
0	849	910	973	1035	1098	1162	1225	1289	1354	1419	1484	1550	1617	1684	0
1	850	911	974	1036	1099	1163	1226	1290	1355	1420	1485	1551	1618	1685	1
2	851	913	975	1037	1100	1164	1227	1291	1356	1421	1486	1552	1619	1686	2
3	852	914	976	1038	1101	1165	1228	1292	1357	1422	1487	1553	1620	1687	3
4	853	915	977	1040	1102	1166	1229	1294	1358	1423	1488	1554	1621	1688	4
5	854	916	978	1041	1104	1167	1230	1295	1359	1424	1490	1556	1622	1689	5
6	855	917	979	1042	1105	1168	1232	1296	1360	1425	1491	1557	1623	1690	6
7	856	918	980	1043	1106	1169	1233	1297	1361	1426	1492	1558	1624	1691	7
8	857	919	981	1044	1107	1170	1234	1298	1362	1427	1493	1559	1625	1693	8
9	858	920	982	1045	1108	1171	1235	1299	1363	1428	1494	1560	1627	1694	9
10	859	921	983	1046	1109	1172	1236	1300	1365	1430	1495	1561	1628	1695	10
11	860	922	984	1047	1110	1173	1237	1301	1366	1431	1496	1562	1629	1696	11
12	861	923	985	1048	1111	1174	1238	1302	1367	1432	1497	1563	1630	1697	12
13	862	924	986	1049	1112	1175	1239	1303	1368	1433	1498	1564	1631	1698	13
14	863	925	987	1050	1113	1176	1240	1304	1369	1434	1499	1565	1632	1699	14
15	864	926	988	1051	1114	1177	1241	1305	1370	1435	1501	1567	1633	1700	15
16	865	927	989	1052	1115	1178	1242	1306	1371	1436	1502	1568	1634	1702	16
17	866	928	990	1053	1116	1180	1243	1307	1372	1437	1503	1569	1635	1703	17
18	867	929	992	1054	1117	1181	1244	1309	1373	1438	1504	1570	1637	1704	18
19	868	930	993	1055	1118	1182	1245	1310	1374	1439	1505	1571	1638	1705	19
20	869	931	994	1056	1119	1183	1246	1311	1375	1440	1506	1572	1639	1706	20
21	870	932	995	1057	1120	1184	1248	1312	1376	1442	1507	1573	1640	1707	21
22	871	933	996	1058	1121	1185	1249	1313	1377	1443	1508	1574	1641	1708	22
23	872	934	997	1059	1122	1186	1250	1314	1379	1444	1509	1575	1642	1709	23
24	873	935	998	1060	1123	1187	1251	1315	1380	1445	1510	1577	1643	1711	24
25	874	936	999	1061	1125	1188	1252	1316	1381	1446	1512	1578	1644	1712	25
26	875	937	1000	1063	1126	1189	1253	1317	1382	1447	1513	1579	1646	1713	26
27	876	938	1001	1064	1127	1190	1254	1318	1383	1448	1514	1580	1647	1714	27
28	878	939	1002	1065	1128	1191	1255	1319	1384	1449	1515	1581	1648	1715	28
29	879	941	1003	1066	1129	1192	1256	1320	1385	1450	1516	1582	1649	1716	29
30	880	942	1004	1067	1130	1193	1257	1321	1386	1451	1517	1583	1650	1717	30
31	881	943	1005	1068	1131	1194	1258	1323	1387	1452	1518	1584	1651	1718	31
32	882	944	1006	1069	1132	1195	1259	1324	1388	1454	1519	1585	1652	1720	32
33	883	945	1007	1070	1133	1196	1260	1325	1389	1455	1520	1587	1653	1721	33
34	884	946	1008	1071	1134	1198	1261	1326	1390	1456	1521	1588	1654	1722	34
35	885	947	1009	1072	1135	1199	1262	1327	1392	1457	1523	1589	1656	1723	35
36	886	948	1010	1073	1136	1200	1264	1328	1393	1458	1524	1590	1657	1724	36
37	887	949	1011	1074	1137	1201	1265	1329	1394	1459	1525	1591	1658	1725	37
38	888	950	1012	1075	1138	1202	1266	1330	1395	1460	1526	1592	1659	1726	38
39	889	951	1013	1076	1139	1203	1267	1331	1396	1461	1527	1593	1660	1727	39
40	890	952	1014	1077	1140	1204	1268	1332	1397	1462	1528	1594	1661	1729	40
41	891	953	1015	1078	1141	1205	1269	1333	1398	1463	1529	1595	1662	1730	41
42	892	954	1017	1079	1142	1206	1270	1334	1399	1464	1530	1597	1663	1731	42
43	893	955	1018	1080	1144	1207	1271	1335	1400	1466	1531	1598	1665	1732	43
44	894	956	1019	1081	1145	1208	1272	1336	1401	1467	1532	1599	1666	1733	44
45	895	957	1020	1083	1146	1209	1273	1338	1402	1468	1534	1600	1667	1734	45
46	896	958	1021	1084	1147	1210	1274	1339	1403	1469	1535	1601	1668	1735	46
47	897	959	1022	1085	1148	1211	1275	1340	1405	1470	1536	1602	1669	1737	47
48	898	960	1023	1086	1149	1212	1276	1341	1406	1471	1537	1603	1670	1738	48
49	899	961	1024	1087	1150	1213	1277	1342	1407	1472	1538	1604	1671	1739	49
50	900	962	1025	1088	1151	1215	1279	1343	1408	1473	1539	1605	1672	1740	50
51	901	963	1026	1089	1152	1216	1280	1344	1409	1474	1540	1607	1673	1741	51
52	902	964	1027	1090	1153	1217	1281	1345	1410	1475	1541	1608	1675	1742	52
53	903	966	1028	1091	1154	1218	1282	1346	1411	1476	1542	1609	1676	1743	53
54	904	967	1029	1092	1155	1219	1283	1347	1412	1478	1543	1610	1677	1744	54
55	905	968	1030	1093	1156	1220	1284	1348	1413	1479	1545	1611	1678	1746	55
56	906	969	1031	1094	1157	1221	1285	1349	1414	1480	1546	1612	1679	1747	56
57	907	970	1032	1095	1158	1222	1286	1350	1415	1481	1547	1613	1680	1748	57
58	908	971	1033	1096	1159	1223	1287	1352	1417	1482	1548	1614	1681	1749	58
59	909	972	1034	1097	1160	1224	1288	1353	1418	1483	1549	1615	1682	1750	59
M.	14d.	15d.	16d.	17d.	18d.	19d.	20d.	21d.	22d.	23d.	24d.	25d.	26d.	27d.	M.

TABLE VI. Meridional Parts.

M.	28d.	29d.	30d.	31d.	32d.	33d.	34d.	35d.	36d.	37d.	38d.	39d.	40d.	41d.	M.
0	1751	1820	1888	1958	2028	2100	2172	2244	2318	2393	2468	2545	2623	2702	0
1	1752	1821	1890	1959	2030	2101	2173	2246	2319	2394	2470	2546	2624	2703	1
2	1753	1822	1891	1960	2031	2102	2174	2247	2321	2395	2471	2548	2625	2704	2
3	1755	1823	1892	1962	2032	2103	2175	2248	2322	2396	2472	2549	2627	2706	3
4	1756	1824	1893	1963	2033	2104	2176	2249	2323	2398	2473	2550	2628	2707	4
5	1757	1825	1894	1964	2034	2106	2178	2250	2324	2399	2475	2551	2629	2708	5
6	1758	1826	1895	1965	2036	2107	2179	2252	2325	2400	2476	2553	2631	2710	6
7	1759	1828	1897	1966	2037	2108	2180	2253	2327	2401	2477	2554	2632	2711	7
8	1760	1829	1898	1967	2038	2109	2181	2254	2328	2403	2479	2555	2633	2712	8
9	1761	1830	1899	1969	2039	2110	2182	2255	2329	2404	2480	2557	2635	2714	9
10	1763	1831	1900	1970	2040	2112	2184	2257	2330	2405	2481	2558	2636	2715	10
11	1764	1832	1901	1971	2041	2113	2185	2258	2332	2406	2482	2559	2637	2716	11
12	1765	1833	1902	1972	2043	2114	2186	2259	2333	2408	2484	2560	2638	2718	12
13	1766	1834	1903	1973	2044	2115	2187	2260	2334	2409	2485	2562	2640	2719	13
14	1767	1836	1905	1974	2045	2116	2188	2261	2335	2410	2486	2563	2641	2720	14
15	1768	1837	1906	1976	2046	2118	2190	2263	2337	2412	2487	2564	2642	2722	15
16	1769	1838	1907	1977	2047	2119	2191	2264	2338	2413	2489	2566	2644	2723	16
17	1771	1839	1908	1978	2049	2120	2192	2265	2339	2414	2490	2567	2645	2724	17
18	1772	1840	1909	1979	2050	2121	2193	2266	2340	2415	2491	2568	2646	2726	18
19	1773	1841	1910	1980	2051	2122	2195	2268	2342	2417	2493	2570	2648	2727	19
20	1774	1842	1912	1981	2052	2123	2196	2269	2343	2418	2494	2571	2649	2728	20
21	1775	1844	1913	1983	2053	2125	2197	2270	2344	2419	2495	2572	2650	2730	21
22	1776	1845	1914	1984	2054	2126	2198	2271	2345	2420	2496	2573	2652	2731	22
23	1777	1846	1915	1985	2056	2127	2199	2273	2347	2422	2498	2575	2653	2732	23
24	1778	1847	1916	1986	2057	2128	2201	2274	2348	2423	2499	2576	2654	2734	24
25	1780	1848	1917	1987	2058	2129	2202	2275	2349	2424	2500	2577	2656	2735	25
26	1781	1849	1919	1988	2059	2131	2203	2276	2350	2425	2501	2579	2657	2736	26
27	1782	1850	1920	1990	2060	2132	2204	2277	2352	2427	2503	2580	2658	2738	27
28	1783	1852	1921	1991	2062	2133	2205	2279	2353	2428	2504	2581	2659	2739	28
29	1784	1853	1922	1992	2063	2134	2207	2280	2354	2429	2505	2582	2661	2740	29
30	1785	1854	1923	1993	2064	2135	2208	2281	2355	2430	2507	2584	2662	2742	30
31	1786	1855	1924	1994	2065	2137	2209	2282	2357	2432	2508	2585	2663	2743	31
32	1788	1856	1925	1996	2066	2138	2210	2284	2358	2433	2509	2586	2665	2744	32
33	1789	1857	1927	1997	2067	2139	2211	2285	2359	2434	2510	2588	2666	2746	33
34	1790	1858	1928	1998	2069	2140	2213	2286	2360	2435	2512	2589	2667	2747	34
35	1791	1860	1929	1999	2070	2141	2214	2287	2361	2437	2513	2590	2669	2748	35
36	1792	1861	1930	2000	2071	2143	2215	2288	2363	2438	2514	2592	2670	2750	36
37	1793	1862	1931	2001	2072	2144	2216	2290	2364	2439	2515	2593	2671	2751	37
38	1794	1863	1932	2003	2073	2145	2218	2291	2365	2440	2517	2594	2673	2752	38
39	1796	1864	1934	2004	2075	2146	2219	2292	2366	2442	2518	2595	2674	2754	39
40	1797	1865	1935	2005	2076	2147	2220	2293	2368	2443	2519	2597	2675	2755	40
41	1798	1867	1936	2006	2077	2149	2221	2295	2369	2444	2521	2598	2677	2756	41
42	1799	1868	1937	2007	2078	2150	2222	2296	2370	2446	2522	2599	2678	2758	42
43	1800	1869	1938	2008	2079	2151	2224	2297	2371	2447	2523	2601	2679	2759	43
44	1801	1870	1939	2010	2081	2152	2225	2298	2373	2448	2524	2602	2681	2760	44
45	1802	1871	1941	2011	2082	2153	2226	2300	2374	2449	2526	2603	2682	2762	45
46	1804	1872	1942	2012	2083	2155	2227	2301	2375	2451	2527	2605	2683	2763	46
47	1805	1873	1943	2013	2084	2156	2229	2302	2376	2452	2528	2606	2684	2764	47
48	1806	1875	1944	2014	2085	2157	2230	2303	2378	2453	2530	2607	2686	2766	48
49	1807	1876	1945	2015	2087	2158	2231	2304	2379	2454	2531	2608	2687	2767	49
50	1808	1877	1946	2017	2088	2159	2232	2306	2380	2456	2532	2610	2688	2768	50
51	1809	1878	1948	2018	2089	2161	2233	2307	2381	2457	2533	2611	2690	2770	51
52	1810	1879	1949	2019	2090	2162	2235	2308	2383	2458	2535	2612	2691	2771	52
53	1811	1880	1950	2020	2091	2163	2236	2309	2384	2459	2536	2614	2692	2772	53
54	1813	1882	1951	2021	2093	2164	2237	2311	2385	2461	2537	2615	2694	2774	54
55	1814	1883	1952	2023	2094	2166	2238	2312	2386	2462	2539	2616	2695	2775	55
56	1815	1884	1953	2024	2095	2167	2239	2313	2388	2463	2540	2618	2696	2776	56
57	1816	1885	1955	2025	2096	2168	2241	2314	2389	2465	2541	2619	2698	2778	57
58	1817	1886	1956	2026	2097	2169	2242	2316	2390	2466	2542	2620	2699	[illegible]	58
59	1818	1887	1957	2027	2099	2170	2243	2317	2391	2467	2544	2621	[illegible]	[illegible]	59
M.	28d.	29d.	30d.	31d.	32d.	33d.	34d.	35d.	36d.	37d.	38d.	39d.	40d.	41d.	M.

TABLE VI. Meridional Parts.

M.	42d.	43d.	44d.	45d.	46d.	47d.	48d.	49d.	50d.	51d.	52d.	53d	54d.	55d.	M.
0	2782	2863	2946	3030	3116	3203	3292	3382	3475	3569	3665	3764	3865	3968	0
1	2783	2865	2947	3031	3117	3204	3293	3384	3476	3570	3667	3765	3866	3970	1
2	2784	2866	2949	3033	3119	3206	3295	3385	3478	3572	3669	3767	3868	3972	2
3	2786	2867	2950	3034	3120	3207	3296	3387	3479	3574	3670	3769	3870	3973	3
4	2787	2869	2951	3036	3121	3209	3298	3388	3481	3575	3672	3770	3872	3975	4
5	2789	2870	2953	3037	3123	3210	3299	3390	3482	3577	3673	3772	3873	3977	5
6	2790	2871	2954	3038	3124	3212	3301	3391	3484	3578	3675	3774	3875	3978	6
7	2791	2873	2956	3040	3126	3213	3302	3392	3485	3580	3677	3775	3877	3980	7
8	2793	2874	2957	3041	3127	3215	3304	3394	3487	3582	3678	3777	3878	3982	8
9	2794	2875	2958	3043	3129	3216	3305	3396	3489	3583	3680	3779	3880	3984	9
10	2795	2877	2960	3044	3130	3217	3307	3397	3490	3585	3682	3780	3882	3986	10
11	2797	2878	2961	3046	3132	3219	3308	3399	3492	3586	3683	3782	3883	3987	11
12	2798	2880	2963	3047	3133	3220	3310	3400	3493	3588	3685	3784	3885	3989	12
13	2799	2881	2964	3048	3134	3222	3311	3402	3495	3590	3686	3786	3887	3991	13
14	2801	2882	2965	3050	3136	3223	3313	3404	3496	3591	3688	3787	3889	3993	14
15	2802	2884	2967	3051	3137	3225	3314	3405	3498	3593	3690	3789	3890	3994	15
16	2803	2885	2968	3053	3139	3226	3316	3407	3500	3594	3691	3791	3892	3996	16
17	2805	2886	2970	3054	3140	3228	3317	3408	3501	3596	3693	3792	3894	3998	17
18	2806	2888	2971	3056	3142	3229	3319	3410	3503	3598	3695	3794	3895	4000	18
19	2807	2889	2972	3057	3143	3231	3320	3411	3504	3599	3696	3796	3897	4001	19
20	2809	2891	2974	3058	3145	3232	3322	3413	3506	3601	3698	3797	3899	4003	20
21	2810	2892	2975	3060	3146	3234	3323	3414	3507	3602	3700	3799	3901	4005	21
22	2811	2893	2977	3061	3147	3235	3325	3416	3509	3604	3701	3801	3902	4007	22
23	2813	2895	2978	3063	3149	3237	3326	3417	3511	3606	3703	3802	3904	4008	23
24	2814	2896	2979	3064	3150	3238	3328	3419	3512	3607	3704	3804	3906	4010	24
25	2816	2897	2981	3065	3152	3240	3329	3420	3514	3609	3706	3806	3907	4012	25
26	2817	2899	2982	3067	3153	3241	3331	3422	3515	3610	3708	3807	3909	4014	26
27	2818	2900	2984	3068	3155	3243	3332	3424	3517	3612	3709	3809	3911	4015	27
28	2820	2902	2985	3070	3156	3244	3334	3425	3518	3614	3711	3811	3913	4017	28
29	2821	2903	2986	3071	3158	3246	3335	3427	3520	3615	3713	3812	3914	4019	29
30	2822	2904	2988	3073	3159	3247	3337	3428	3521	3617	3714	3814	3916	4021	30
31	2824	2906	2989	3074	3160	3248	3338	3430	3523	3618	3716	3816	3918	4022	31
32	2825	2907	2991	3075	3162	3250	3340	3431	3525	3620	3718	3817	3920	4024	32
33	2826	2908	2992	3077	3163	3251	3341	3433	3526	3622	3719	3819	3921	4026	33
34	2828	2910	2993	3078	3165	3253	3343	3434	3528	3623	3721	3821	3923	4028	34
35	2829	2911	2995	3080	3166	3254	3344	3436	3529	3625	3722	3822	3925	4030	35
36	2830	2913	2996	3081	3168	3256	3346	3437	3531	3626	3724	3824	3926	4031	36
37	2832	2914	2998	3083	3169	3257	3347	3439	3532	3628	3726	3826	3928	4033	37
38	2833	2915	2999	3084	3171	3259	3349	3440	3534	3630	3727	3827	3930	4035	38
39	2835	2917	3000	3085	3172	3260	3350	3442	3536	3631	3729	3829	3932	4037	39
40	2836	2918	3002	3087	3174	3262	3352	3444	3537	3633	3731	3831	3933	4038	40
41	2837	2920	3003	3088	3175	3263	3353	3445	3539	3635	3732	3833	3935	4040	41
42	2839	2921	3005	3090	3176	3265	3355	3447	3540	3636	3734	3834	3937	4042	42
43	2840	2922	3006	3091	3178	3266	3356	3448	3542	3638	3736	3836	3939	4044	43
44	2841	2924	3007	3093	3179	3268	3358	3450	3544	3639	3737	3838	3940	4045	44
45	2843	2925	3009	3094	3181	3269	3359	3451	3545	3641	3739	3839	3942	4047	45
46	2844	2926	3010	3096	3182	3271	3361	3453	3547	3643	3741	3841	3944	4049	46
47	2845	2928	3012	3097	3184	3272	3362	3454	3548	3644	3742	3843	3945	4051	47
48	2847	2929	3013	3098	3185	3274	3364	3456	3550	3646	3744	3844	3947	4053	48
49	2848	2931	3014	3100	3187	3275	3365	3457	3551	3647	3746	3846	3949	4054	49
50	2850	2932	3016	3101	3188	3277	3367	3459	3553	3649	3747	3848	3951	4056	50
51	2851	2933	3017	3103	3190	3278	3368	3461	3555	3651	3749	3849	3952	4058	51
52	2852	2935	3019	3104	3191	3280	3370	3462	3556	3652	3751	3851	3954	4060	52
53	2854	2936	3020	3106	3193	3281	3372	3464	3558	3654	3752	3853	3956	4061	53
54	2855	2938	3022	3107	3194	3283	3373	3465	3559	3656	3754	3855	3958	4063	54
55	2856	2939	3023	3108	3195	3284	3375	3467	3561	3657	3756	3856	3959	4065	55
56	2858	2940	3024	3110	3197	3286	3376	3468	3563	3659	3757	3858	3961	4067	56
57	2859	2942	3026	3111	3198	3287	3378	3470	3564	3660	3759	3860	3963	4069	57
58	2861	2943	3027	3113	3200	3289	3379	3471	3566	3662	3760	3861	3965	4070	58
59	2862	2944	3029	3114	3201	3290	3381	3473	3567	3664	3762	3864	3966	4072	59
M.	42d.	43d.	44d.	45d.	46d.	47d.	48d.	49d.	50d.	51d.	52d.	53d.	54d.	55d.	M.

M.	56d.	57d.	58d.	59d.	60d.	61d.	62d.	63d.	64d.	65d.	66d.	67d.	68d.	69d.	M
0	4074	4183	4294	4409	4527	4649	4775	4905	5040	5179	5324	5474	5631	5795	0
1	4076	4185	4296	4411	4529	4651	4777	4907	5042	5181	5326	5477	5634	5797	1
2	4078	4186	4298	4413	4531	4653	4779	4909	5044	5184	5329	5479	5636	5800	2
3	4079	4188	4300	4415	4533	4656	4781	4912	5046	5186	5331	5482	5639	5803	3
4	4081	4190	4302	4417	4535	4658	4784	4914	5049	5188	5333	5484	5642	5806	4
5	4083	4192	4304	4419	4537	4660	4786	4916	5051	5191	5336	5487	5644	5809	5
6	4085	4194	4306	4421	4539	4662	4788	4918	5053	5193	5338	5489	5647	5811	6
7	4087	4196	4308	4423	4541	4664	4790	4920	5056	5195	5341	5492	5650	5814	7
8	4088	4197	4310	4425	4543	4666	4792	4923	5058	5198	5343	5495	5652	5817	8
9	4090	4199	4311	4427	4545	4668	4794	4925	5060	5200	5346	5497	5655	5820	9
10	4092	4201	4313	4429	4548	4670	4796	4927	5062	5203	5348	5500	5658	5823	10
11	4094	4203	4315	4431	4550	4672	4799	4929	5065	5205	5351	5502	5660	5825	11
12	4096	4205	4317	4433	4552	4674	4801	4932	5067	5207	5353	5505	5663	5828	12
13	4097	4207	4319	4435	4555	4676	4803	4934	5069	5210	5356	5508	5666	5831	13
14	4099	4208	4321	4436	4556	4678	4805	4936	5072	5212	5358	5510	5668	5834	14
15	4101	4210	4323	4438	4558	4680	4807	4938	5074	5215	5361	5513	5671	5837	15
16	4103	4212	4325	4440	4560	4682	4809	4940	5076	5217	5363	5515	5674	5840	16
17	4105	4214	4327	4442	4562	4685	4811	4943	5078	5219	5366	5518	5677	5842	17
18	4106	4216	4328	4444	4564	4687	4814	4945	5081	5222	5368	5520	5679	5845	18
19	4108	4218	4330	4446	4566	4689	4816	4947	5083	5224	5371	5523	5682	5848	19
20	4110	4220	4332	4448	4568	4691	4818	4949	5085	5227	5373	5526	5685	5851	20
21	4112	4221	4334	4450	4570	4693	4820	4952	5088	5229	5376	5528	5687	5854	21
22	4114	4223	4336	4452	4572	4695	4822	4954	5090	5231	5378	5531	5690	5857	22
23	4115	4225	4338	4454	4574	4697	4824	4956	5092	5234	5381	5533	5693	5859	23
24	4117	4227	4340	4456	4576	4699	4827	4958	5095	5236	5383	5536	5696	5862	24
25	4119	4229	4342	4458	4578	4701	4829	4960	5097	5239	5386	5539	5698	5865	25
26	4121	4231	4344	4460	4580	4703	4831	4963	5099	5241	5388	5541	5701	5868	26
27	4123	4233	4346	4462	4582	4705	4833	4965	5102	5243	5390	5544	5704	5871	27
28	4124	4234	4348	4464	4584	4707	4835	4967	5104	5246	5393	5546	5706	5874	28
29	4126	4236	4349	4466	4586	4710	4837	4969	5106	5248	5396	5549	5709	5876	29
30	4128	4238	4351	4468	4588	4712	4839	4972	5109	5251	5398	5552	5712	5879	30
31	4130	4240	4353	4470	4590	4714	4842	4974	5111	5253	5401	5554	5715	5882	31
32	4132	4242	4355	4472	4592	4716	4844	4976	5113	5255	5403	5557	5717	5885	32
33	4133	4244	4357	4474	4594	4718	4846	4978	5116	5258	5406	5560	5720	5888	33
34	4135	4246	4359	4476	4596	4720	4848	4981	5118	5260	5408	5562	5723	5891	34
35	4137	4247	4361	4478	4598	4723	4850	4983	5120	5263	5411	5565	5726	5894	35
36	4139	4249	4363	4480	4600	4724	4853	4985	5123	5265	5413	5567	5728	5896	36
37	4141	4251	4365	4482	4602	4726	4855	4987	5125	5267	5416	5570	5731	5899	37
38	4143	4253	4367	4484	4604	4728	4857	4990	5127	5270	5418	5573	5734	5902	38
39	4144	4255	4369	4486	4606	4731	4859	4992	5130	5272	5421	5575	5736	5905	39
40	4146	4257	4371	4488	4608	4733	4861	4994	5132	5275	5423	5578	5739	5908	40
41	4148	4259	4373	4490	4610	4735	4863	4996	5134	5277	5426	5581	5742	5911	41
42	4150	4261	4374	4492	4612	4737	4866	4999	5137	5280	5428	5583	5745	5914	42
43	4152	4262	4376	4494	4614	4739	4868	5001	5139	5282	5431	5586	5748	5917	43
44	4153	4264	4378	4496	4616	4741	4870	5003	5141	5284	5433	5588	5750	5920	44
45	4155	4266	4380	4498	4618	4743	4872	5005	5144	5287	5436	5591	5753	5922	45
46	4157	4268	4382	4500	4621	4745	4874	5008	5146	5289	5438	5594	5756	5925	46
47	4159	4270	4384	4502	4623	4747	4876	5010	5148	5292	5441	5596	5759	5928	47
48	4161	4272	4386	4504	4625	4750	4879	5012	5151	5294	5444	5599	5761	5931	48
49	4163	4274	4388	4506	4627	4752	4881	5014	5153	5297	5446	5602	5764	5934	49
50	4164	4276	4390	4508	4629	4754	4882	5017	5155	5299	5449	5604	5767	5937	50
51	4166	4277	4392	4509	4631	4756	4885	5019	5158	5302	5451	5607	5770	5940	51
52	4168	4279	4394	4511	4633	4758	4887	5021	5160	5304	5454	5610	5772	5943	52
53	4170	4281	4396	4513	4635	4760	4890	5024	5162	5306	5456	5612	5775	5946	53
54	4172	4283	4398	4515	4637	4762	4892	5026	5165	5309	5459	5615	5778	5949	54
55	4174	4285	4400	4517	4639	4764	4894	5028	5167	5311	5461	5618	5781	5951	55
56	4175	4287	4401	4519	4641	4767	4896	5030	5169	5314	5464	5620	5784	5954	56
57	4177	4289	4403	4521	4643	4769	4898	5033	5172	5316	5466	5623	5786	5957	57
58	4179	4291	4405	4523	4645	4771	4901	5035	5174	5319	5469	5626	5789	5960	58
59	4181	4293	4407	4525	4647	4773	4903	5037	5177	5321	5472	5628	5792	5963	59
M.	56d.	57d.	58d.	59d.	60d.	61d.	62d.	63d.	64d.	65d.	66d.	67d.	68d.	69d.	M

TABLE VI. MERIDIONAL PARTS.

M.	70d.	71d.	72d.	73d.	74d.	75d.	76d.	77d.	78d.	79d.	80d.	81d.	82d.	83d.	M.
0	5966	6146	6335	6535	6746	6970	7210	7467	7745	8046	8375	8739	9146	9606	0
1	5969	6149	6338	6538	6749	6974	7214	7472	7749	8051	8381	8746	9153	9614	1
2	5972	6152	6341	6541	6753	6978	7218	7476	7754	8056	8387	8752	9160	9622	2
3	5975	6155	6345	6545	6757	6982	7223	7481	7759	8062	8393	8758	9167	9631	3
4	5978	6158	6348	6548	6760	6986	7227	7485	7764	8067	8398	8765	9174	9639	4
5	5981	6161	6351	6552	6764	6990	7231	7490	7769	8072	8404	8771	9182	9647	5
6	5984	6164	6354	6555	6768	6994	7235	7494	7774	8077	8410	8778	9189	9656	6
7	5987	6167	6358	6559	6771	6998	7239	7499	7778	8083	8416	8784	9196	9664	7
8	5989	6170	6361	6562	6775	7001	7243	7503	7783	8088	8422	8791	9204	9672	8
9	5992	6174	6364	6565	6779	7005	7248	7507	7788	8093	8427	8797	9211	9681	9
10	5995	6177	6367	6569	6782	7009	7252	7512	7793	8099	8433	8804	9218	9689	10
11	5998	6180	6371	6572	6786	7013	7256	7516	7798	8104	8439	8810	9225	9697	11
12	6001	6183	6374	6576	6790	7017	7260	7521	7803	8109	8445	8817	9233	9706	12
13	6004	6186	6377	6579	6793	7021	7264	7525	7808	8115	8451	8823	9240	9714	13
14	6007	6189	6381	6583	6797	7025	7268	7530	7813	8120	3457	8830	9248	9723	14
15	6010	6192	6384	6586	6801	7029	7273	7535	7817	8125	8463	8836	9255	9731	15
16	6013	6195	6387	6590	6804	7033	7277	7539	7822	8131	8469	8843	9262	9740	16
17	6016	6198	6390	6593	6808	7037	7281	7544	7827	8136	8475	8849	9270	9748	17
18	6019	6201	6394	6597	6812	7041	7285	7548	7832	8141	8480	8856	9277	9757	18
19	6022	6205	6397	6600	6816	7045	7289	7553	7837	8147	8486	8863	9285	9765	19
20	6025	6208	6400	6603	6819	7048	7294	7557	7842	8152	8492	8869	9292	9774	20
21	6028	6211	6404	6607	6823	7052	7298	7562	7847	8158	8498	8876	9300	9783	21
22	6031	6214	6407	6610	6826	7056	7302	7566	7852	8163	8504	8883	9307	9791	22
23	6034	6217	6410	6614	6830	7060	7306	7571	7857	8168	8510	8889	9315	9800	23
24	6037	6220	6413	6617	6834	7064	7311	7576	7862	8174	8516	8896	9322	9809	24
25	6040	6223	6417	6621	6838	7068	7315	7580	7867	8179	8522	8903	9330	9817	25
26	6043	6227	6420	6624	6841	7072	7319	7585	7872	8185	8528	8909	9338	9826	26
27	6046	6230	6423	6628	6845	7076	7323	7589	7877	8190	8534	8916	9345	9835	27
28	6049	6233	6427	6631	6849	7080	7328	7594	7882	8196	8540	8923	9353	9844	28
29	6052	6236	6430	6635	6853	7084	7332	7598	7887	8201	8546	8930	9360	9852	29
30	6055	6239	6433	6639	6856	7088	7336	7603	7892	8207	8552	8936	9368	9861	30
31	6058	6242	6437	6642	6860	7092	7341	7608	7897	8212	8558	8943	9376	9870	31
32	6061	6245	6440	6646	6864	7096	7345	7612	7902	8218	8564	8950	9384	9879	32
33	6064	6249	6443	6649	6868	7100	7349	7617	7907	8223	8571	8957	9391	9888	33
34	6067	6252	6447	6653	6871	7104	7353	7622	7912	8229	8577	8963	9399	9897	34
35	6070	6255	6450	6656	6875	7108	7358	7626	7917	8234	8583	8970	9407	9906	35
36	6073	6258	6453	6660	6879	7112	7362	7631	7922	8240	8589	8977	9414	9915	36
37	6076	6261	6457	6663	6883	7116	7366	7636	7927	8245	8595	8984	9422	9924	37
38	6079	6264	6460	6667	6886	7120	7371	7640	7932	8251	8601	8991	9430	9933	38
39	6082	6268	6463	6670	6890	7124	7375	7645	7937	8256	8607	8998	9438	9942	39
40	6085	6271	6467	6674	6894	7128	7379	7650	7942	8262	8614	9005	9446	9951	40
41	6088	6274	6470	6677	6898	7132	7384	7654	7948	8267	8620	9012	9453	9960	41
42	6091	6277	6473	6681	6901	7136	7388	7659	7953	8273	8626	9018	9461	9969	42
43	6094	6280	6477	6685	6905	7140	7392	7664	7958	8279	8632	9025	9469	9978	43
44	6097	6284	6480	6688	6909	7145	7397	7668	7963	8284	8638	9032	9477	9987	44
45	6100	6287	6484	6692	6913	7149	7401	7673	7968	8290	8645	9039	9485	9996	45
46	6103	6290	6487	6695	6917	7153	7406	7678	7973	8296	8651	9046	9493	10010	46
47	6106	6293	6490	6699	6920	7157	7410	7683	7978	8301	8657	9053	9501	10015	47
48	6109	6296	6494	6702	6924	7161	7414	7687	7983	8307	8663	9060	9509	10024	48
49	6112	6299	6497	6706	6928	7165	7419	7692	7989	8312	8670	9067	9517	10033	49
50	6115	6303	6500	6710	6932	7169	7423	7697	7994	8318	8676	9074	9525	10043	50
51	6118	6306	3504	6713	6936	7173	7427	7702	7999	8324	8682	9081	9533	10052	51
52	6121	6309	6507	6717	6940	7177	7432	7706	8004	8329	8688	9089	9541	10061	52
53	6124	6312	6511	6720	6943	7181	7436	7711	8009	8335	8695	9096	9549	10071	53
54	6127	6316	6514	6724	6947	7185	7441	7716	8014	8341	8701	9103	9557	10080	54
55	6130	6319	6517	6728	6951	7190	7445	7721	8020	8347	8707	9110	9565	10089	55
56	6134	6322	6521	6731	6955	7194	7450	7725	8025	8352	8714	9117	9573	10099	56
57	6137	6325	6524	6735	6959	7198	7454	7730	8030	8358	8720	9124	9581	10108	57
58	6140	6328	6528	6739	6963	7202	7458	7735	8035	8364	8726	9131	9590	10118	58
59	6143	6332	6531	6742	6967	7206	7463	7740	8041	8370	8733	9138	9598	10127	59
M.	70d.	71d.	72d.	73d.	74d.	75d.	76d.	77d.	78d.	79d.	80d.	81d.	82d.	83d.	M.

TABLE VII.

MEAN REFRACTION.

App. Alt.	Refr.	App. Alt.	Refr.	App. Alt.	Refr.	App. Alt.	Refr.	App. Alt.	Refr.
° ′	′ ″	° ′	′ ″	° ′	′ ″	° ′	′ ″	° ′	′ ″
0. 0	33. 0	5. 0	9.54	10. 0	5.15	20. 0	2.35	34. 0	1.24
0. 5	32.10	5. 5	9.46	10.10	5.10	20.10	2.34	34.30	1.23
0.10	31.22	5.10	9.38	10.20	5. 5	20.20	2.32	35. 0	1.21
0.15	30.35	5.15	9.30	10.30	5. 0	20.30	2.31	35.30	1.20
0.20	29.50	5.20	9.23	10.40	4.56	20.40	2.29	36. 0	1.18
0.25	29. 0	5.25	9.15	10.50	4.51	20.50	2.28	36.30	1.17
0.30	28.23	5.30	9. 8	11. 0	4.47	21. 0	2.27	37. 0	1.16
0.35	27.41	5.35	9. 1	11.10	4.43	21.10	2.26	37.30	1.14
0.40	27. 0	5.40	8.54	11.20	4.39	21.20	2.25	38. 0	1.13
0.45	26.20	5.45	8.47	11.30	4.34	21.30	2.24	38.30	1.11
0.50	25.42	5.50	8.41	11.40	4.31	21.40	2.23	39. 0	1.10
0.55	25. 5	5.55	8.34	11.50	4.27	21.50	2.21	39.30	1. 9
1. 0	24.29	6. 0	8.28	12. 0	4.23	22. 0	2.20	40. 0	1. 8
1. 5	23.54	6. 5	8.21	12.10	4.20	22.10	2.19	41. 0	1. 5
1.10	23.20	6.10	8.15	12.20	4.16	22.20	2.18	42. 0	1. 3
1.15	22.47	6.15	8. 9	12.30	4.13	22.30	2.17	43. 0	1. 1
1.20	22.15	6.20	8. 3	12.40	4. 9	22.40	2.16	44. 0	0.59
1.25	21.44	6.25	7.57	12.50	4. 6	22.50	2.15	45. 0	0.57
1.30	21.15	6.30	7.51	13. 0	4. 3	23. 0	2.14	46. 0	0.55
1.35	20.46	6.35	7.45	13.10	4. 0	23.10	2.13	47. 0	0.53
1.40	20.18	6.40	7.40	13.20	3.57	23.20	2.12	48. 0	0.51
1.45	19.51	6.45	7.35	13.30	3.54	23.30	2.11	49. 0	0.49
1.50	19.25	6.50	7.30	13.40	3.51	23.40	2.10	50. 0	0.48
1.55	19. 0	6.55	7.25	13.50	3.48	23.50	2. 9	51. 0	0.46
2. 0	18.35	7. 0	7.20	14. 0	3.45	24. 0	2. 8	52. 0	0.44
2. 5	18.11	7. 5	7.15	14.10	3.43	24.10	2. 7	53. 0	0.43
2.10	17.48	7.10	7.11	14.20	3.40	24.20	2. 6	54. 0	0.41
2.15	17.26	7.15	7. 6	14.30	3.38	24.30	2. 5	55. 0	0.40
2.20	17. 4	7.20	7. 2	14.40	3.35	24.40	2. 4	56. 0	0.38
2.25	16.44	7.25	6.57	14.50	3.33	24.50	2. 3	57. 0	0.36
2.30	16.24	7.30	6.53	15. 0	3.30	25. 0	2. 2	58. 0	0.35
2.35	16. 4	7.35	6.49	15.10	3.28	25.10	2. 1	59. 0	0.34
2.40	15.45	7.40	6.45	15.20	3.26	25.20	2. 0	60. 0	0.33
2.45	15.27	7.45	6.41	15.30	3.24	25.30	1.59	61. 0	0.32
2.50	15. 9	7.50	6.37	15.40	3.21	25.40	1.58	62. 0	0.30
2.55	14.52	7.55	6.33	15.50	3.19	25.50	1.57	63. 0	0.29
3. 0	14.36	8. 0	6.29	16. 0	3.17	26. 0	1.56	64. 0	0.28
3. 5	14.20	8. 5	6.25	16.10	3.15	26.10	1.55	65. 0	0.26
3.10	14. 4	8.10	6.22	16.20	3.12	26.20	1.55	66. 0	0.25
3.15	13.49	8.15	6.18	16.30	3.10	26.30	1.54	67. 0	0.24
3.20	13.34	8.20	6.15	16.40	3. 8	26.40	1.53	68. 0	0.23
3.25	13.20	8.25	6.11	16.50	3. 6	26.50	1.52	69. 0	0.22
3.30	13. 6	8.30	6. 8	17. 0	3. 4	27. 0	1.51	70. 0	0.21
3.35	12.53	8.35	6. 5	17.10	3. 3	27.15	1.50	71. 0	0.19
3.40	12.40	8.40	6. 1	17.20	3. 1	27.30	1.49	72. 0	0.18
3.45	12.27	8.45	5.58	17.30	2.59	27.45	1.48	73. 0	0.17
3.50	12.15	8.50	5.55	17.40	2.57	28. 0	1.47	74. 0	0.16
3.55	12. 3	8.55	5.52	17.50	2.55	28.15	1.46	75. 0	0.15
4. 0	11.51	9. 0	5.48	18. 0	2.54	28.30	1.45	76. 0	0.14
4. 5	11.40	9. 5	5.45	18.10	2.52	28.45	1.44	77. 0	0.13
4.10	11.29	9.10	5.42	18.20	2.51	29. 0	1.42	78. 0	0.12
4.15	11.18	9.15	5.39	18.30	2.49	29.30	1.40	79. 0	0.11
4.20	11. 8	9.20	5.36	18.40	2.47	30. 0	1.38	80. 0	0.10
4.25	10.58	9.25	5.34	18.50	2.46	30.30	1.37	81. 0	0. 9
4.30	10.48	9.30	5.31	19. 0	2.44	31. 0	1.35	82. 0	0. 8
4.35	10.39	9.35	5.28	19.10	2.43	31.30	1.33	83. 0	0. 7
4.40	10.29	9.40	5.25	19.20	2.41	32. 0	1.31	84. 0	0. 6
4.45	10.20	9.45	5.23	19.30	2.40	32.30	1.30	86. 0	0. 4
4.50	10.11	9.50	5.20	19.40	2.38	33. 0	1.28	88. 0	0. 2
4.55	10. 2	9.55	5.18	19.50	2.37	33.30	1.26	90. 0	0. 0

TAB. VIII. Dip. of the Horizon.

Height.	Dip.
Feet.	′ ″
1	0.58
2	1.21
3	1.40
4	1.56
5	2. 9
6	2.21
7	2.33
8	2.44
9	2.53
10	3. 2
11	3.10
12	3.19
13	3.27
14	3.36
15	3.42
16	3.50
17	3.57
18	4. 4
19	4.11
20	4.17
21	4.23
22	4.30
23	4.36
24	4.42
26	4.52
28	5. 5
30	5.15
35	5.39
40	6. 4
45	6.27
50	6.46
60	7.25
70	8. 1
80	8.34
90	9. 6
100	9.35

TAB. IX. Sun's Parallax in Alt.

Alt.	Parall.
°	″
0	9
10	9
20	8
30	8
40	7
50	6
55	5
60	4
65	4
70	3
75	2
80	2
85	1
90	0

TABLE X. Moon Augmentat.

Alt.	Augm.
°	″
0	0
5	1
10	3
15	4
20	6
25	7
30	8
35	9
40	10
45	11
50	12
55	13
60	14
70	15
80	15
90	16

TABLE XI.

Dip. at differ. Distances from the Observer.

Miles.	Height of the Eye in Feet.					
	5′	10′	15′	20′	25′	30′
¼	11	23	34	45	57	68
½	6	12	17	23	28	34
¾	4	8	12	15	19	23
1	3	6	9	12	15	17
1¼	3	5	7	10	12	14
1½	3	4	6	8	10	12
2	2	4	5	7	8	9
2½	2	3	4	6	7	8
3	2	3	4	5	6	7
3½	2	3	4	5	6	6
4	2	3	4	4	5	6
5	2	3	4	4	5	6
6	2	3	4	4	5	5

TABLE XII.

A TABLE

OF

SUN'S DECLINATION,

For the Years 1810, 1814, 1818, 1822,

BEING THE SECOND AFTER LEAP YEAR.

rch.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
uth.	North.	North.	North.	North.	North.	North.	South.	South.	South.
′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
43	4.24	14.57	22. 0	23.10	18. 9	8.27	3. 2	14 .	21.46
20	4.47	15.16	22. 9	23. 6	17.54	8. 5	3.25	14.	21.56

TABLE XII.

A TABLE

OF

THE SUN'S DECLINATION,

For the Years, 1811, 1815, 1819, 1823,

BEING THE THIRD AFTER LEAP YEAR.

Days.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	South.	South.	South.	North.	North.	North.	North.	North.	North.	South.	South.	South.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1	23. 4	17.16	7.48	4.18	14.53	21.58	23.11	18.13	8.32	2.56	14.15	21.44
2	22.59	16.59	7.25	4.42	15.11	22. 7	23. 7	17.58	8.11	3.19	14.34	21.53
3	22.54	16.41	7. 3	5. 5	15.29	22.15	23. 2	17.42	7.49	3.43	14.53	22. 2
4	22.48	16.24	6.40	5.28	15.47	22.22	22.58	17.27	7.27	4. 6	15.12	22.11
5	22.41	16. 6	6.17	5.50	16. 4	22.29	22.52	17.11	7. 4	4.29	15.31	22.19
6	22.35	15.47	5.53	6.13	16.21	22.36	22.47	16.55	6.42	4.52	15.49	22.27
7	22.27	15.29	5.30	6.36	16.38	22.42	22.41	16.38	6.20	5.15	16. 7	22.34
8	22.20	15.10	5. 7	6.58	16.55	22.48	22.35	16.21	5.57	5.38	16.25	22.41
9	22.12	14.51	4.43	7.21	17.11	22.53	22.28	16. 4	5.35	6. 1	16.42	22.47
10	22. 3	14.32	4.20	7.43	17.27	22.59	22.21	15.47	5.12	6.24	16.59	22.53
11	21.54	14.13	3.67	8. 5	17.43	23. 3	22.13	15.30	4.49	6.47	17.16	22.58
12	21.45	13.53	3.33	8.27	17.58	23. 7	22. 5	15.12	4.26	7.10	17.33	23. 3
13	21.35	13.33	3. 9	8.49	18.14	23.11	21.57	14.54	4. 4	7.32	18.49	23. 8
14	21.25	13.13	2.46	9.11	18.28	23.15	21.49	14.36	3.41	7.55	18. 5	23.12
15	21.14	12.52	2.22	9.33	18.43	23.18	21.40	14.17	3.17	8.17	18.21	23.16
16	21. 3	12.32	1.59	9.54	18.57	23.20	21.30	13.58	2.54	8.40	18.36	23.19
17	20.52	12.11	1.35	10.15	19.11	23.23	21.20	13.40	2.31	9. 2	18.51	23.21
18	20.40	11.50	1.11	10.36	19.25	23.25	21.10	13.20	2. 8	9.24	19. 6	23.24
19	20.26	11.29	0.47	10.57	19.38	23.26	21. 0	13. 1	1.45	9.46	19.21	23.25
20	20.15	11. 7	0.24S.	11.18	19.51	23.27	20.49	12.41	1.21	10. 7	19.35	23.27
21	20. 2	10.46	0. 0	11.39	20. 3	23.28	20.38	12.22	0.58	10.29	19.48	23.27
22	19.49	10.24	0.24N.	11.59	20.16	23.28	20.26	12. 2	0.35	10.50	20. 2	23.28
23	19.35	10. 2	0.47	12.19	20.28	23.27	20.14	11.41	0.11N.	11.12	20.14	23.28
24	19.21	9.40	1.11	12.39	20.39	23.27	20. 2	11.21	0.12S.	11.33	20.27	23.27
25	19. 6	9.18	1.35	12.59	20.50	23.26	19.50	11. 1	0.36	11.54	20.39	23.26
26	18.52	8.56	1.58	13.19	21. 1	23.24	19.37	10.40	0.59	12.15	20.51	23.24
27	18.36	8.33	2.22	13.38	21.12	23.22	19.24	10.19	1.23	12.35	21. 2	23.22
28	18.21	8.11	2.45	13.57	21.22	23.20	19.10	9.58	1.46	12.55	21.13	23.20
29	18. 5		3. 9	14.16	21.32	23.17	18.56	9.37	2. 9	13.16	21.24	23.17
30	17.49		3.32	14.35	21.41	23.14	18.42	9.15	2.33	13.36	21.34	23.18
31	17.32		3.55		21.50		18.28	8.54		13.55		23. 9

A TABLE

OF

E SUN'S DECLINATION,

For the Years 1812, 1816, 1820, 1824,

EACH BEING LEAP YEAR.

March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
South.	North.	North.	North.	North.	North.	North.	South.	South.	South.
° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
7.31	4.36	15. 7	22. 5	23. 8	18. 1	8.16	3.14	14.29	21.51
7. 8	4.59	15.25	22.13	23. 3	17.46	7.54	3.37	14.48	22.00

[redacted]

TABLE XII.

A TABLE

OF

THE SUN'S DECLINATION,

For the Years 1813, 1817, 1821, 1825,

BEING THE FIRST AFTER LEAP YEAR.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	South.	South.	South.	North.	North.	North.	North.	North.	North.	South.	South.	South.
Days.	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1	23. 1	17. 7	7.37	4.30	15. 2	22. 3	23. 9	18. 5	8.21	3. 8	14.25	21.49
2	22.56	16.50	7.14	4.53	15.21	22.11	23. 5	17.50	7.59	3.31	14.44	21.58
3	22.51	16.32	6.51	5.16	15.38	22.18	23. 0	17.35	7.37	3.55	15. 3	22. 7
4	22.45	16.14	6.28	5.39	15.56	22.26	22.55	17.19	7.15	4.18	15.22	22.15
5	22.38	15.56	6. 5	6. 2	16.13	22.33	22.50	17. 3	6.53	4.41	15.40	22.23
6	22.31	15.38	5.41	6.25	16.30	22.39	22.44	16.46	6.31	5. 4	15.58	22.30
7	22.24	15.19	5.18	6.47	16.47	22.45	22.38	16.30	6. 8	5.27	16.16	22.37
8	22.16	15. 0	4.55	7.10	17. 3	22.51	22.31	16.13	5.46	5.50	16.34	22.44
9	22. 7	14.41	4.31	7.32	17.20	22.56	22.24	15.56	5.23	6.13	16.51	22.50
10	21.59	14.22	4. 8	7.55	17.35	23. 1	22.17	15.38	5. 1	6.36	17. 8	22.56
11	21.49	14. 2	3.44	8.17	17.51	23. 5	22. 9	15.21	4.38	6.59	17.25	23. 1
12	21.40	13.43	3.21	8.39	18. 6	23.10	22. 1	15. 3	4.15	7.21	17.41	23. 6
13	21.30	13.22	2.57	9.00	18.21	23.13	21.53	14.45	3.52	7.44	17.58	23.10
14	21.19	13. 2	2.34	9.22	18.36	23.16	21.44	14.26	3.29	8. 6	18.13	23.14
15	21. 9	12.42	2.10	9.44	18.50	23.19	21.35	14. 8	3. 6	8.29	18.29	23.17
16	20.57	12.21	1.46	10. 5	19. 4	23.22	21.25	13.49	2.43	8.51	18.44	23.20
17	20.46	12. 0	1.23	10.26	19.18	23.24	21.15	13.30	2.19	9.13	18.59	23.23
18	20.34	11.39	0.59	10.47	19.32	23.25	21. 5	13.11	1.56	9.35	19.14	23.25
19	20.21	11.18	0.35	11. 8	19.45	23.27	20.54	12.51	1.33	9.57	19.28	23.26
20	20. 8	10.56	0.12 S.	11.29	19.57	23.27	20.43	12.32	1.10	10.18	19.42	23.27
21	19.55	10.35	0.12N.	11.49	20.10	23.28	20.32	12.12	0.46	10.40	19.55	23.28
22	19.42	10.13	0.36	12. 9	20.22	23.28	20.20	11.52	0.23N.	11. 1	20. 8	23.28
23	19.28	9.51	0.59	12.30	20.34	23.27	20. 8	11.31	0. 1S.	11.22	20.21	23.27
24	19.13	9.29	0.23	12.49	20.45	23.26	19.56	11.11	0.24	11.44	20.33	23.26
25	18.59	9. 7	1.47	13. 9	20.56	23.25	19.43	10.50	0.48	12. 4	20.45	23.25
26	18.44	8.44	2.10	13.29	21. 7	23.23	19.30	10.29	1.11	12.25	20.57	23.23
27	18.29	8.22	2.34	13.48	21.17	23.21	19.17	10. 8	1.34	12.46	21. 8	23.21
28	18.13	7.59	2.57	14. 7	21.27	23.19	19. 3	9.47	1.58	13. 6	21.19	23.18
29	17.57		3.20	14.26	21.36	23.16	18.49	9.26	2.21	13.26	21.29	23.15
30	17.41		3.44	14.44	21.46	23.12	18.35	9. 5	2.45	13.46	21.39	23.11
31	17.24		4. 7		21.54		18.20	8.43		14. 5		23. [illegible]

TABLE XIII.

...n's Declination to any Meridian, and to any Time under that
...ing Proportional Parts of the Daily Difference of the Sun's
...ery Hour, and to every Fifteen Degrees of Longitude.

5	1 45.0	2 2.5	2 20.0	2 37.5	2 55.0	3 12.5	3 30.0
0	2 0.0	2 20.0	2 40.0	3 0.0	3 20.0	3 40.0	4 0.0
5	2 15.0	2 37.5	3 0.0	3 22.5	3 45.0	4 7.5	4 30.0
0	2 30.0	2 55.0	3 20.0	3 45.0	4 10.0	4 35.0	5 0.0
5	2 45.0	3 12.5	3 40.0	4 7.5	4 35.0	5 2.5	5 30.0
0	3 0.0	3 30.0	4 0.0	4 30.0	5 0.0	5 30.0	6 0.0
5	3 15.0	3 47.5	4 20.8	4 52.5	5 25.0	5 57.5	6 30.0
0	3 30.0	4 5.0	4 40.0	5 15.0	5 50.0	6 25.0	7 0.0
5	3 45.0	4 22.5	5 0.0	5 37.5	6 15.0	6 52.5	7 30.0
0	4 0.0	4 40.0	5 20.0	6 0.0	6 40.0	7 20.0	8 0.0
5	4 15.0	4 57.5	5 40.0	6 22.5	7 5.0	7 47.5	8 30.0
0	4 30.0	5 15.0	6 0.0	6 45.0	7 30.0	8 15.0	9 0.0
5	4 45.0	5 32.5	6 20.0	7 7.5	7 55.0	8 42.5	9 30.0
0	5 0.0	5 50.0	6 40.0	7 30.0	8 20.0	9 10.0	10 0.0
5	5 15.0	6 7.5	7 0.0	7 52.5	8 45.0	9 37.5	10 30.0
0	5 30.0	6 25.0	7 20.0	8 15.0	9 10.0	10 5.0	11 0.0
0	5 45.0	6 42.5	7 40.0	8 37.5	9 35.0	10 32.5	11 30.0
0	6 0.0	7 0.0	8 0.0	9 0.0	10 0.0	11 0.0	12 0.0
2	0 1.5	0 1.7	0 2.0	0 2.2	0 2.5	0 2.7	0 3.0
5	0 3.0	0 3.5	0 4.0	0 4.5	0 5.0	0 5.5	0 6.0
7	0 4.5	0 5.2	0 6.0	0 6.7	0 7.5	0 8.2	0 9.0
0	0 6.0	0 7.0	0 8.0	0 9.0	0 10.0	0 11.0	0 12.0
2	0 7.5	0 8.7	0 10.0	0 11.2	0 12.5	0 13.7	0 15.0
5	0 9.0	0 10.5	0 12.0	0 13.5	0 15.0	0 16.5	0 18.0
7	0 10.5	0 12.2	0 14.0	0 15.7	0 17.5	0 19.2	0 21.0
0	0 12.0	0 14.0	0 16.0	0 18.0	0 20.0	0 22.0	0 24.0
2	[illegible] 13.5	0 15.7	0 18.0	0 20.2	0 22.5	0 24.7	0 27.0

TABLE XIII.

For reducing the Sun's Declination to any Meridian, and to any Time under that Meridian; containing Proportional Parts of the Daily Difference of the Sun's Declination to every Hour, and to every Fifteen Degrees of Longitude.

	Time.	XIII. H.	XIV. H.	XV. H.	XVI. H.	XVII. H.	XVIII. H.	XIX. H.	XX. H.	XXI. H.	XXII. H.	XXIII. H.	XXIV. H.
	Long.	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°	360°
Daily Difference of Declination in Minutes and		′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
	1	0 32.5	0 35.0	0 37.5	0 40.0	0 42.5	0 45.0	0 47.5	0 50.0	0 52.5	0 55.0	0 57.5	1 0.0
	2	1 5.0	1 10.0	1 15.0	1 20.0	1 25.0	1 30.0	1 35.0	1 40.0	1 45.0	1 50.0	1 55.0	2 0.0
	3	1 37.5	1 45.0	1 52.5	2 0.0	2 7.5	2 15.0	2 22.5	2 30.0	2 37.5	2 45.0	2 52.5	3 0.0
	4	2 10.0	2 20.0	2 30.0	2 40.0	2 50.0	3 0.0	3 10.0	3 20.0	3 30.0	3 40.0	3 50.0	4 0.0
	5	2 42.5	2 55.0	3 7.5	3 20.0	3 32.5	3 45.0	3 57.5	4 10.0	4 22.5	4 35.0	4 37.5	5 0.0
	6	3 15.0	3 30.0	3 45.0	4 0.0	4 15.0	4 30.0	4 45.0	5 0.0	5 15.0	5 30.0	5 45.0	6 0.0
	7	3 47.5	4 5.0	4 22.5	4 40.0	4 57.5	5 15.0	5 32.5	5 50.0	6 7.5	6 25.0	6 42.5	7 0.0
	8	4 20.0	4 40.0	5 0.0	5 20.0	5 40.0	6 0.0	6 20.0	6 40.0	7 0.0	7 20.0	7 40.0	8 0.0
	9	4 52.5	5 15.0	5 37.5	6 0.0	6 22.5	6 45.0	7 7.5	7 30.0	7 52.5	8 15.0	8 37.5	9 0.0
	10	5 25.0	5 50.0	6 15.0	6 40.0	7 5.0	7 30.0	7 55.0	8 20.0	8 45.0	9 10.0	9 35.0	10 0.0
	11	5 57.5	6 25.0	6 52.5	7 20.0	7 47.5	8 15.0	8 42.5	9 10.0	9 37.5	10 5.0	10 32.5	11 0.0
	12	6 30.0	7 0.0	7 30.0	8 0.0	8 30.0	9 0.0	9 30.0	10 0.0	10 30.0	11 0.0	11 30.0	12 0.0
	13	7 2.5	7 35.0	8 7.5	8 40.0	9 12.5	9 45.0	10 17.5	10 50.0	11 22.5	11 55.0	12 27.5	13 0.0
	14	7 35.0	8 10.0	8 45.0	9 20.0	9 55.0	10 30.0	11 5.0	11 40.0	12 15.0	12 50.0	13 25.0	14 0.0
	15	8 7.5	8 45.0	9 22.5	10 0.0	10 37.5	11 15.0	11 52.5	12 30.0	13 7.5	13 45.0	14 22.5	15 0.0
	16	8 40.0	9 20.0	10 0.0	10 40.0	11 20.0	12 0.0	12 40.0	13 20.0	14 0.0	14 40.0	15 20.0	16 0.0
	17	9 12.5	9 55.0	10 37.5	11 20.0	12 2.5	12 45.0	13 27.5	14 10.0	14 52.5	15 35.0	16 17.5	17 0.0
	18	9 45.0	10 30.0	11 15.0	12 0.0	12 45.0	13 30.0	14 15.0	15 0.0	15 45.0	16 30.0	17 15.0	18 0.0
	19	10 17.5	11 5.0	11 52.5	12 40.0	13 27.5	14 15.0	15 2.5	15 50.0	16 37.5	17 25.0	18 12.5	19 0.0
	20	10 50.0	11 40.0	12 30.0	13 20.0	14 10.0	15 0.0	15 50.0	16 40.0	17 30.0	18 20.0	19 10.0	20 0.0
	21	11 22.5	12 15.0	13 7.5	14 0.0	14 52.5	15 45.0	16 37.5	17 30.0	18 22.5	19 15.0	20 7.5	21 0.0
	22	11 55.0	12 50.0	13 45.0	14 40.0	15 35.0	16 30.0	17 25.0	18 20.0	19 15.0	20 10.0	21 5.0	22 0.0
	23	12 27.5	13 25.0	14 22.5	15 20.0	16 17.5	17 15.0	18 12.5	19 10.0	20 7.5	21 5.0	22 2.5	23 0.0
	24	13 0.0	14 0.0	15 0.0	16 0.0	17 0.0	18 0.0	19 0.0	20 0.0	21 0.0	22 0.0	23 0.0	24 0.0
every six Seconds.	6	0 3.2	0 3.5	0 3.7	0 4.0	0 4.2	0 4.5	0 4.7	0 5.0	0 5.2	0 5.5	0 5.7	0 6.0
	12	0 6.5	0 7.0	0 7.5	0 8.0	0 8.5	0 9.0	0 9.5	0 10.0	0 10.5	0 11.0	0 11.5	0 12.0
	18	0 9.7	0 10.5	0 11.2	0 12.0	0 12.7	0 13.5	0 14.2	0 15.0	0 15.7	0 16.5	0 17.2	0 18.0
	24	0 13.0	0 14.0	0 15.0	0 16.0	0 17.0	0 18.0	0 19.0	0 20.0	0 21.0	0 22.0	0 23.0	0 24.0
	30	0 16.2	0 17.5	0 18.7	0 20.0	0 21.2	0 22.5	0 23.7	0 25.0	0 26.2	0 27.5	0 28.7	0 30.0
	36	0 19.5	0 21.0	0 22.5	0 24.0	0 25.5	0 27.0	0 28.5	0 30.0	0 31.5	0 33.0	0 34.5	0 36.0
	42	0 22.7	0 24.5	0 26.2	0 28.0	0 29.7	0 31.5	0 33.2	0 35.0	0 36.7	0 38.5	0 40.2	0 42.0
	48	0 26.0	0 28.0	0 30.0	0 32.0	0 34.0	0 36.0	0 38.0	0 40.0	0 42.0	0 44.0	0 46.0	0 48.0
	54	0 29.2	0 31.5	0 33.7	0 36.0	0 38.2	0 40.5	0 42.7	0 45.0	0 47.2	0 49.5	0 51.7	0 54.0

TABLE XIII.

's Declination to any Meridian, and to any Time under that
ining Proportional Parts of the daily Difference of the Sun's
ery five Minutes in the Hour; and to every Degree, and fif-
ngitude.

0 8.7	0 10.2	0 11.7	0 13.1	0 14.6	0 16.0	0 17.5
0 10.0	0 11.7	0 13.3	0 15.0	0 16.7	0 18.3	0 20.0
0 11.2	0 13.1	0 15.0	0 16.9	0 18.7	0 20.6	0 22.5
0 12.5	0 14.6	0 16.7	0 18.7	0 20.8	0 22.9	0 25.0
0 13.7	0 16.0	0 18.3	0 20.6	0 22.9	0 25.2	0 27.5
0 15.0	0 17.5	0 20.0	0 22.5	0 25.0	0 27.5	0 30.0
0 16.2	0 19.0	0 21.7	0 24.4	0 27.1	0 29.8	0 32.5
0 17.5	0 20.4	0 23.3	0 26.2	0 29.2	0 32.1	0 35.0
0 18.7	0 21.9	0 25.0	0 28.1	0 31.2	0 34.4	0 37.5
0 20.0	0 23.3	0 26.7	0 30.0	0 33.3	0 36.7	0 40.0
0 21.2	0 24.8	0 28.3	0 31.9	0 35.4	0 39.0	0 42.5
0 22.5	0 26.2	0 30.0	0 33.7	0 37.5	0 41.1	0 45.0
0 23.7	0 27.7	0 31.7	0 35.6	0 39.6	0 43.5	0 47.5
0 25.0	0 29.2	0 33.3	0 37.5	0 41.7	0 45.8	0 50.0
0 26.2	0 30.6	0 35.0	0 39.4	0 43.7	0 48.1	0 52.5
0 27.5	0 32.1	0 36.7	0 41.2	0 45.8	0 50.4	0 55.0
0 28.7	0 33.5	0 38.3	0 43.1	0 47.9	0 52.7	0 57.5
0 30.0	0 35.0	0 40.0	0 45.0	0 50.0	0 58.0	1 0.0
0 0.1	0 0.1	0 0.2	0 0.2	0 0.2	0 0.2	0 0.2
0 0.2	0 0.3	0 0.3	0 0.4	0 0.4	0 0.5	0 0.5
0 0.4	0 0.4	0 0.5	0 0.6	0 0.6	0 0.7	0 0.7
0 0.5	0 0.6	0 0.7	0 0.7	0 0.8	0 0.9	0 1.0
0 0.6	0 0.7	0 0.8	0 0.9	0 1.0	0 1.1	0 1.2
0 0.7	0 0.9	0 1.0	0 1.1	0 1.2	0 1.4	0 1.5
0 0.9	0 1.0	0 1.2	0 1.3	0 1.5	0 1.6	0 1.8
0 1.0	0 1.2	0 1.3	0 1.5	0 1.7	0 1.8	0 2.0
0 1.1	0 1.3	0 1.5	0 1.7	0 1.6	0 2.1	0 2.2

A TABLE

OF

THE SUN'S RIGHT ASCENSION.

	Jan.		Feb.		Mar.		April.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		
Days.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M	H.	M	Days.
1	18	46	20	58	22	47	0	41	2	32	4	35	6	39	8	44	10	40	12	28	14	24	16	28	1
2	18	50	21	02	22	51	0	44	2	36	4	39	6	43	8	48	10	44	12	32	14	28	16	32	2
3	18	55	21	06	22	55	0	48	2	40	4	43	6	47	8	51	10	47	12	35	14	32	16	37	3
4	18	59	21	10	22	58	0	52	2	43	4	47	6	51	8	55	10	51	12	39	14	36	16	41	4
5	19	03	21	14	23	02	0	55	2	47	4	51	6	55	8	59	10	54	12	43	14	40	16	45	5
6	19	08	21	18	23	06	0	59	2	51	4	55	6	59	9	03	10	58	12	46	14	44	16	50	6
7	19	12	21	22	23	10	1	03	2	55	4	59	7	04	9	07	11	02	12	50	14	48	16	54	7
8	19	17	21	26	23	13	1	06	2	59	5	03	7	08	9	11	11	05	12	54	14	52	16	58	8
9	19	21	21	30	23	17	1	10	3	03	5	07	7	12	9	15	11	09	12	57	14	56	17	03	9
10	19	25	21	34	23	21	1	14	3	07	5	12	7	16	9	18	11	12	13	01	15	00	17	07	10
11	19	30	21	38	23	24	1	17	3	11	5	16	7	20	9	22	11	16	13	05	15	04	17	12	11
12	19	34	21	42	23	38	1	21	3	14	5	20	7	24	9	26	11	20	13	08	15	08	17	16	12
13	19	38	21	46	23	32	1	25	3	18	5	24	7	28	9	30	11	23	13	12	15	12	17	20	13
14	19	43	21	50	23	35	1	28	3	22	5	28	7	32	9	33	11	27	13	16	15	16	17	25	14
15	19	47	21	54	23	39	1	32	3	26	5	32	7	36	9	37	11	30	13	19	15	20	17	29	15
16	19	51	21	58	23	43	1	36	3	30	5	36	7	40	9	41	11	34	13	23	15	24	17	34	16
17	19	55	22	02	23	46	1	39	3	34	5	41	7	44	9	45	11	38	13	27	15	29	17	38	17
18	20	00	22	06	23	50	1	43	3	38	5	45	7	48	9	48	11	41	13	31	15	33	17	42	18
19	20	04	22	09	23	54	1	47	3	42	5	49	7	52	9	52	11	45	13	34	15	37	17	47	19
20	20	08	22	13	23	57	1	51	3	46	5	53	7	56	9	56	11	48	13	38	15	41	17	51	20
21	20	12	22	17	0	01	1	54	3	50	5	57	8	00	10	00	11	52	13	42	15	45	17	56	21
22	20	17	22	21	0	05	1	58	3	54	6	01	8	04	10	03	11	56	13	46	15	49	18	00	22
23	20	21	22	25	0	08	2	02	3	58	6	06	8	08	10	07	11	59	13	49	15	54	18	05	23
24	20	25	22	28	0	12	2	06	4	02	6	10	8	12	10	11	12	03	13	53	15	58	18	09	24
25	20	29	22	32	0	15	2	09	4	06	6	14	8	16	10	14	12	06	13	57	16	02	18	14	25
26	20	33	22	36	0	19	2	13	4	10	6	18	8	20	10	18	12	10	14	01	16	06	18	18	26
27	20	38	22	40	0	23	2	17	4	14	6	22	8	24	10	22	12	14	14	05	16	11	18	22	27
28	20	42	22	44	0	26	2	21	4	18	6	26	8	28	10	25	12	17	14	09	16	15	18	27	28
29	20	46			0	30	2	24	4	22	6	30	8	32	10	29	12	21	14	12	16	19	18	31	29
30	20	50			0	34	2	28	4	26	6	35	8	36	10	33	12	24	14	16	16	24	18	36	30
31	20	54			0	37			4	30			8	40	10	36			14	20			18	40	31

This table is sufficiently exact for finding when any star comes to the meridian, in order to obtain the latitude; but in all calculations for determining the true apparent time, the sun's right ascension must be taken out of the Nautical Almanack, as it is there calculated to a greater degree of accuracy. If the Sun's right ascension be wanted in degrees, it is readily found by converting time into degrees, by means of Table XVI.

TABLE XV.

…ensions and Declinations of the principal fixed Stars, adapted to the Beginning of the Year 1810.

…the Stars.	Right Ascension in Time.	Right Ascension in Ann. Var.	Right Ascension in Degrees.	Declination.		Ann. Var.
	H. M. S.	Sec.	° ′ ″	° ′ ″		Sec.
....	0 3 27	+ 3.06	0 51 45	14 7 36	N.	+20. 0
....	0 29 55	3.31	7 28 45	55 29 28	—	+19.91
....	0 54 29	12.89	13 37 15	88 18 08	—	+19. 6
....	0 59 07	3.30	14 46 45	34 37 23	—	+19. 4
....	1 52 18	3.62	28 4 30	41 24 29	—	+17.80
....	1 56 29	3.34	29 7 15	22 33 34	—	+17. 5
....	2 52 23	3.12	43 5 45	3 20 28	—	+14. 6
....	2 55 52	3.85	43 58 0	40 12 52	—	+14. 4
....	3 36 13	3.55	53 3 15	23 28 22	—	+12. 0
....	4 9 01	3.39	62 15 15	15 9 38	—	+ 9.60
....	4 25 02	3.42	66 15 30	16 7 8	—	+ 8. 1
....	5 2 41	4.41	75 40 15	45 47 41		+ 5. 0
....	5 14 57	3.21	78 44 15	6 10 3	—	+ 4. 0
....	5 44 53	3.24	86 13 15	7 21 41	—	+ 1. 4
....	7 22 27	3.85	110 36 45	32 17 31	—	— 6. 9
....	7 29 21	3.14	112 20 15	5 42 54	—	— 7. 5
....	7 33 40	3.69	113 25 0	28 28 29	—	— 7. 9
....	8 48 3	3.24	132 0 45	12 35 12	—	—13.30
....	9 58 14	3.20	149 33 30	12 53 29	—	—17. 2
....	10 50 18	3.71	162 34 30	57 23 53	—	—19.10
....	10 51 54	3.82	162 58 30	62 46 31	—	—19.14
....	12 45 44	2.69	191 26 0	56 59 54	—	—19.69
....	13 40 2	2.39	205 0 30	50 26 1	—	—18. 1
....	14 6 39	2.72	211 39 45	20 10 34	—	—19. 1
....	14 45 47	2.63	221 26 45	27 52 41	—	—15.67
....	15 26 38	2.53	231 39 30	27 21 44	—	—12. 4

TABLE XVI.

For turning Degrees and Minutes into Time, and the contrary.

D	H M	D	H M	D	H M	D	H M	D	H M	D	H M	D M	M
M	M S	M	M S	M	M S	M	M S	M	M S	M	M S	M S	Sec.
												S T	Th.
1	0. 4	61	4. 4	121	8. 4	181	12. 4	241	16. 4	301	20. 4	0 15	1
2	0. 8	62	4. 8	122	8. 8	182	12. 8	242	16. 8	302	20. 8	0 30	2
3	0.12	63	4.12	123	8.12	183	12.12	243	16.12	303	20.12	0 45	3
4	0.16	64	4.16	124	8.16	184	12.16	244	16.16	304	20.16	1 0	4
5	0.20	65	4.20	125	8.20	185	12.20	245	16.20	305	20.20	1 15	5
6	0.24	66	4.24	126	8.24	186	12.24	246	16.24	306	20.24	1 30	6
7	0.28	67	4.28	127	8.28	187	12.28	247	16.28	307	20.28	1 45	7
8	0.32	68	4.32	128	8.32	188	12.32	248	16.32	308	20.32	2 0	8
9	0.36	69	4.36	129	8.36	189	12.36	249	16.36	309	20.36	2 15	9
10	0.40	70	4.40	130	8.40	190	12.40	250	16.40	310	20.40	2 30	10
11	0.44	71	4.44	131	8.44	191	12.44	251	16.44	311	20.44	2 45	11
12	0.48	72	4.48	132	8.48	192	12.48	252	16.48	312	20.48	3 0	12
13	0.52	73	4.52	133	8.52	193	12.52	253	16.52	313	20.52	3 15	13
14	0.56	74	4.56	134	8.56	194	12.56	254	16.56	314	20.56	3 30	14
15	1. 0	75	5. 0	135	9. 0	195	13. 0	255	17. 0	315	21. 0	3 45	15
16	1. 4	76	5. 4	136	9. 4	196	13. 4	256	17. 4	316	21. 4	4 0	16
17	1. 8	77	5. 8	137	9. 8	197	13. 8	257	17. 8	317	21. 8	4 15	17
18	1.12	78	5.12	138	9.12	198	13.12	258	17.12	318	21.12	4 30	18
19	1.16	79	5.16	139	9.16	199	13.16	259	17.16	319	21.16	4 45	19
20	1.20	80	5.20	140	9.20	200	13.20	260	17.20	320	21.20	5 0	20
21	1.24	81	5.24	141	9.24	201	13.24	261	17.24	321	21.24	5 15	21
22	1.28	82	5.28	142	9.28	202	13.28	262	17.28	322	21.28	5 30	22
23	1.32	83	5.32	143	9.32	203	13.32	263	17.32	323	21.32	5 45	23
24	1.36	84	5.36	144	9.36	204	13.36	264	17.36	324	21.36	6 0	24
25	1.40	85	5.40	145	9.40	205	13.40	265	17.40	325	21.40	6 15	25
26	1.44	86	5.44	146	9.44	206	13.44	266	17.44	326	21.44	6 30	26
27	1.48	87	5.48	147	9.48	207	13.48	267	17.48	327	21.48	6 45	27
28	1.52	88	5.52	148	9.52	208	13.52	268	17.52	328	21.52	7 0	28
29	1.56	89	5.56	149	9.56	209	13.56	269	17.56	329	21.56	7 15	29
30	2. 0	90	6. 0	150	10. 0	210	14. 0	270	18. 0	330	22. 0	7 30	30
31	2. 4	91	6. 4	151	10. 4	211	14. 4	271	18. 4	331	22. 4	7 45	31
32	2. 8	92	6. 8	152	10. 8	212	14. 8	272	18. 8	332	22. 8	8 0	32
33	2.12	93	6.12	153	10.12	213	14.12	273	18.12	333	22.12	8 15	33
34	2.16	94	6.16	154	10.16	214	14.16	274	18.16	334	22.16	8 30	34
35	2.20	95	6.20	155	10.20	215	14.20	275	18.20	335	22.20	8 45	35
36	2.24	96	6.24	156	10.24	216	14.24	276	18.24	336	22.24	9 0	36
37	2.28	97	6.28	157	10.28	217	14.28	277	18.28	337	22.28	9 15	37
38	2.32	98	6.32	158	10.32	218	14.32	278	18.32	338	22.32	9 30	38
39	2.36	99	6.36	159	10.36	219	14.36	279	18.36	339	22.36	9 45	39
40	2.40	100	6.40	160	10.40	220	14.40	280	18.40	340	22.40	10 0	40
41	2.44	101	6.44	161	10.44	221	14.44	281	18.44	341	22.44	10 15	41
42	2.48	102	6.48	162	10.48	222	14.48	282	18.48	342	22.48	10 30	42
43	2.52	103	6.52	163	10.52	223	14.52	283	18.52	343	22.52	10 45	43
44	2.56	104	6.56	164	10.56	224	14.56	284	18.56	344	22.56	11 0	44
45	3. 0	105	7. 0	165	11. 0	225	15. 0	285	19. 0	345	23. 0	11 15	45
46	3. 4	106	7. 4	166	11. 4	226	15. 4	286	19. 4	346	23. 4	11 30	46
47	3. 8	107	7. 8	167	11. 8	227	15. 8	287	19. 8	347	23. 8	11 45	47
48	3.12	108	7.12	168	11.12	228	15.12	288	19.12	348	23.12	12 0	48
49	3.16	109	7.16	169	11.16	229	15.16	289	19.16	349	23.16	12 15	49
50	3.20	110	7.20	170	11.20	230	15.20	290	19.20	350	23.20	12 30	50
51	3.24	111	7.24	171	11.24	231	15.24	291	19.24	351	23.24	12 45	51
52	3.28	112	7.28	172	11.28	232	15.28	292	19.28	352	23.28	13 0	52
53	3.32	113	7.32	173	11.32	233	15.32	293	19.32	353	23.32	13 15	53
54	3.36	114	7.36	174	11.36	234	15.36	294	19.36	354	23.36	13 30	54
55	3.40	115	7.40	175	11.40	235	15.40	295	19.40	355	23.40	13 45	55
56	3.44	116	7.44	176	11.44	236	15.44	296	19.44	356	23.44	14 0	56
57	3.48	117	7.48	177	11.48	237	15.48	297	19.48	357	23.48	14 15	57
58	3.52	118	7.52	178	11.52	238	15.52	298	19.52	358	23.52	14 30	58
59	3.56	119	7.56	179	11.56	239	15.56	299	19.56	359	23.56	14 45	59
60	4. 0	120	8. 0	180	12. 0	240	16. 0	300	20. 0	360	24. 0	15 0	60

TABLE XVII.

ime of the Moon's Passage over the Meridian of Green-
the Time of its Passage over any other Meridian

ly Variation of the Moon's passing the Meridian.											Time from ☽ Southing
46′	48′	50′	52′	54′	56′	58′	60′	62′	64′	66′	
m	m	m	m	m	m	m	m	m	m	m	H. M.
0	0	0	0	0	0	0	0	0	0	0	0 0
1	1	1	1	1	1	1	1	1	1	1	0 20
1	1	1	1	1	1	2	2	2	2	2	0 40
2	2	2	2	2	2	2	2	3	3	3	1 0
2	3	3	3	3	3	3	3	3	4	4	1 20
3	3	3	4	4	4	4	4	4	4	5	1 40
4	4	4	4	4	5	5	5	5	5	5	2 0
5	5	5	5	5	5	6	6	6	6	6	2 20
5	5	6	6	6	6	6	7	7	7	7	2 40
6	6	6	6	7	7	7	7	8	8	8	3 0
6	7	7	7	7	8	8	8	9	9	9	3 20
7	8	8	8	8	9	9	9	9	10	10	3 40
8	8	8	9	9	9	10	10	10	11	11	4 0
8	9	9	9	10	10	10	11	11	12	12	4 20
9	9	10	10	10	11	11	12	12	12	13	4 40
10	10	10	11	11	12	12	12	13	13	14	5 0
10	11	11	12	12	12	13	13	14	14	15	5 20
11	11	12	12	13	13	14	14	15	15	16	5 20
11	12	12	13	13	14	14	15	15	16	16	6 40
12	13	13	14	14	15	15	16	16	17	17	6 20
13	13	14	14	15	16	16	17	17	18	18	6 40
13	14	15	15	16	16	17	17	18	19	19	7 0
14	15	15	16	16	17	18	18	19	20	20	7 20
15	15	16	17	17	18	19	19	20	20	21	7 40
15	16	17	17	18	19	19	20	21	21	22	8 0

TABLE XVIII.

Decimals to every Minute in Twelve Hours.

M.	0	1	2	3	4	5	6	7	8	9	10	11
0		.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167
1	.0013	.0846	.1680	.2513	.3346	.4180	.5013	.5846	.6680	.7513	.8346	.9180
2	.0028	.0861	.1695	.2528	.3361	.4195	.5028	.5861	.6695	.7528	.8361	.9195
3	.0042	.0875	.1709	.2542	.3375	.4209	.5042	.5875	.6709	.7542	.8375	.9206
4	.0055	.0888	.1722	.2555	.3388	.4222	.5055	.5888	.6722	.7555	.8388	.9222
5	.0069	.0902	.1736	.2569	.3402	.4236	.5069	.5902	.6736	.7569	.8402	.9236
6	.0083	.0916	.1750	.2583	.3416	.4250	.5083	.5916	.6750	.7583	.8416	.9250
7	.0097	.0930	.1764	.2597	.3430	.4264	.5097	.5930	.6764	.7597	.8430	.9264
8	.0111	.0944	.1778	.2611	.3444	.4278	.5111	.5944	.6778	.7611	.8444	.9278
9	.0125	.0958	.1792	.2625	.3458	.4292	.5125	.5958	.6792	.7625	.8458	.9292
10	.0139	.0972	.1806	.2639	.3472	.4306	.5139	.5972	.6806	.7639	.8472	.9306
11	.0152	.0985	.1819	.2652	.3485	.4319	.5151	.5985	.6819	.7652	.8485	.9319
12	.0167	.1000	.1834	.2667	.3500	.4334	.5167	.6000	.6834	.7667	.8500	.9334
13	.0181	.1014	.1848	.2681	.3514	.4348	.5181	.6014	.6848	.7681	.8514	.9348
14	.0194	.1027	.1861	.2694	.3527	.4361	.5194	.6027	.6861	.7694	.8527	.9361
15	.0208	.1041	.1875	.2708	.3541	.4375	.5218	.6041	.6875	.7708	.8541	.9375
16	.0222	.1055	.1889	.2722	.3555	.4389	.5222	.6055	.6889	.7722	.8555	.9389
17	.0236	.1069	.1903	.2736	.3569	.4403	.5236	.6069	.6903	.7736	.8569	.9403
18	.0250	.1083	.1917	.2750	.3583	.4417	.5250	.6083	.6917	.7750	.8583	.9417
19	.0264	.1097	.1931	.2764	.3597	.4431	.5264	.6097	.6931	.7764	.8597	.9431
20	.0278	.1111	.1945	.2778	.3611	.4445	.5278	.6111	.6945	.7778	.8611	.9445
21	.0292	.1125	.1959	.2792	.3625	.4459	.5292	.6125	.6959	.7792	.8625	.9459
22	.0306	.1139	.1973	.2806	.3639	.4473	.5306	.6139	.6973	.7806	.8639	.9473
23	.0319	.1152	.1986	.2819	.3652	.4486	.5319	.6152	.6986	.7819	.8652	.9486
24	.0333	.1166	.2000	.2833	.3666	.4500	.5333	.6166	.7000	.7233	.8666	.9500
25	.0347	.1180	.2014	.2847	.3680	.4514	.5347	.6180	.7014	.7847	.8680	.9514
26	.0361	.1194	.2028	.2861	.3694	.4528	.5361	.6194	.7028	.7861	.8694	.9528
27	.0375	.1208	.2042	.2875	.3708	.4542	.5375	.6208	.7042	.7875	.8708	.9542
28	.0389	.1222	.2056	.2889	.3722	.4556	.5389	.6292	.7056	.7889	.8722	.9556
29	.0403	.1236	.2070	.2903	.3736	.4570	.5403	.6236	.7070	.7903	.8746	.9570
30	.0417	.1250	.2084	.2917	.3750	.4584	.5417	.6250	.7084	.7917	.8750	.9584
31	.0481	.1264	.2098	.2931	.3764	.4598	.5431	.6264	.7098	.7931	.8764	.9598
32	.0444	.1277	.2111	.2944	.3777	.4611	.5444	.6277	.7111	.7944	.8777	.9611
33	.0458	.1291	.2125	.2958	.3791	.4625	.5458	.6291	.7125	.7958	.8791	.9625
34	.0472	.1305	.2139	.2972	.3805	.4639	.5472	.6305	.7139	.7972	.8805	.9639
35	.0486	.1319	.2153	.2986	.3819	.4653	.5486	.6319	.7153	.7986	.8819	.9653
36	.0500	.1333	.2167	.3000	.3833	.4667	.5500	.6333	.7167	.8900	.8833	.9667
37	.0514	.1347	.2181	.2014	.3847	.4681	.5514	.6347	.7181	.8014	.8847	.9681
38	.0528	.1361	.2195	.3028	.3861	.4695	.5528	.6361	.7195	.8028	.8861	.9695
39	.0542	.1375	.2209	.3042	.3875	.4709	.5542	.6375	.7209	.8042	.8875	.9709
40	.0556	.1389	.2223	.3056	.3889	.4723	.5556	.6389	.7223	.8056	.8889	.9723
41	.0569	.1402	.2236	.3069	.3902	.4736	.5569	.6402	.7236	.8069	.8902	.9736
42	.0583	.1416	.2250	.3083	.3916	.4750	.5583	.6416	.7250	.8083	.8916	.9750
43	.0597	.1430	.2264	.3097	.3930	.4764	.5597	.6430	.7264	.8097	.8930	.9764
44	.0611	.1444	.2278	.3111	.3944	.4778	.5611	.6444	.7278	.8111	.8944	.9778
45	.0625	.1458	.2292	.3125	.3958	.4792	.5625	.6458	.7292	.8125	.8958	.9792
46	.0639	.1472	.2306	.3139	.3972	.4806	.5639	.6472	.7306	.8139	.8972	.9806
47	.0653	.1486	.2320	.3153	.3986	.4820	.5653	.6486	.7320	.8153	.8986	.9820
48	.0667	.1500	.2334	.3167	.4000	.4834	.5667	.6500	.7334	.8167	.9000	.9834
49	.0681	.1514	.2348	.3181	.4014	.4848	.5681	.6514	.7348	.8181	.9014	.9848
50	.0694	.1527	.2361	.3194	.4027	.4861	.5694	.6527	.7361	.8194	.9027	.9861
51	.0708	.1541	.2375	.3208	.4041	.4875	.5708	.6541	.7375	.8208	.9941	.9875
52	.0722	.1555	.2389	.3222	.4055	.4889	.5722	.6555	.7389	.8222	.9055	.9889
53	.0736	.1569	.2403	.3236	.4069	.4903	.5736	.6569	.7403	.8236	.9069	.9903
54	.0750	.1583	.2417	.3250	.4083	.4917	.5750	.6583	.7417	.8250	.9083	.9917
55	.0764	.1597	.2431	.3264	.4097	.4931	.5764	.6597	.7431	.8264	.9097	.9931
56	.0778	.1611	.2445	.3278	.4111	.4945	.5778	.6611	.7445	.8272	.9111	.9945
57	.0792	.1625	.2459	.3292	.4125	.4959	.5792	.6625	.7459	.8292	.9125	.9959
58	.0806	.1639	.2473	.3306	.4139	.4973	.5806	.6639	.7473	.8306	.9139	.9973
59	.0819	.1652	.2486	.3319	.4151	.4986	.5819	.6652	.7486	.8319	.9152	[illegible]

TABLE XIX. AMPLITUDES.

3	13. 3	14. 3	15. 4	16. 4	17. 4	18. 4	19. 5	20. 5	21. 5	22. 5	23. 6	23.34	5
4	13. 4	14. 5	15. 5	16. 5	17. 6	18. 6	19. 7	20. 7	21. 7	22. 8	23. 8	23.36	6
5	13. 6	14. 6	15. 7	16. 7	17. 8	18. 8	19. 9	20. 9	21.10	22.10	23.11	23.39	7
7	13. 8	14. 8	15. 9	16.10	17.10	18.11	19.12	20.12	21.13	22.14	23.14	23.43	8
9	13.10	14.11	15.11	16.12	17.13	18.14	19.15	20.16	21.16	22.17	23.18	23.47	9
1	13.12	14.13	15.14	16.15	17.16	18.17	19.18	20.19	21.20	22.21	23.23	23.51	10
4	13.15	14.16	15.17	16.18	17.20	18.21	19.22	20.23	21.25	22.26	23.27	23.56	11
6	13.18	14.19	15.21	16.22	17.24	18.25	19.26	20.28	21.30	22.31	23.33	24. 1	12
9	13.21	14.23	15.24	16.26	17.28	18.29	19.31	20.33	21.35	22.37	23.38	24. 7	13
2	13.24	14.26	15.28	16.30	17.32	18.34	19.36	20.38	21.40	22.43	23.45	24.14	14
6	13.28	14.30	15.33	16.35	17.37	17.39	19.42	20.44	21.47	22.49	23.52	24.21	15
9	13.32	14.35	15.37	16.40	17.42	18.45	19.48	20.51	21.53	22.56	23.59	24.28	16
3	13.36	14.39	15.42	16.45	17.48	18.51	19.54	20.57	22. 1	23. 4	24. 7	24.36	17
8	13.41	14.44	15.48	16.51	17.54	18.58	20. 1	21. 5	22. 8	23.12	24.15	24.45	18
2	13.46	14.49	15.53	16.57	18. 1	19. 5	20. 8	21.12	22.16	23.20	24.25	24.54	19
7	13.51	14.55	15.59	17. 3	18. 8	19.12	20.16	21.21	22.25	23.30	24.34	25. 4	20
2	13.57	15. 1	16. 6	17.10	18.15	19 20	20.25	21.29	22.34	23.39	24.45	25.15	21
7	14. 2	15. 7	16.13	17.18	18.23	19.28	20.33	21.39	22.44	23.50	24.55	25.26	22
3	14. 9	15.14	16.20	17.25	18.31	19.37	20.43	21.49	22.55	24. 1	25. 7	25.38	23
9	14.15	15.21	16.27	17.34	18.40	19.46	20.53	21.59	23. 6	24.13	25.19	25.51	24
6	14.22	15.29	16.36	17.42	18.49	19.56	21. 3	22.10	23.18	24.25	25.32	26. 4	25
2	14.30	15.37	16.44	17.52	18.59	20. 7	21.14	22.22	23.30	24.38	25.46	26.18	26
0	14.37	15.45	16.53	18. 1	19. 9	20.18	21.26	22.34	23.43	24.52	26. 1	26.33	27
7	14.46	15.54	17. 3	18.11	19.20	20.29	21.38	22.47	23.57	25. 6	26.16	26.48	28
5	14.54	16. 3	17.13	18.22	19.32	20.41	21.51	23. 1	24.11	25.22	26.32	27. 5	29
3	15. 3	16.13	17.23	18.34	19.44	20.54	22. 5	23.16	24.27	25.38	26.49	27.23	30
2	15.13	16.24	17.34	18.45	19.57	21. 8	22.19	23.31	24.43	25.55	[illegible]	27.41	31
1	15.23	16.34	17.46	18.58	20.10	21.22	22.35	23.47	25. 0	26.13	27.26	28. 0	32
1	15.34	16.46	17.59	19.11	20.24	21.37	22.51	24. 4	25.18	26.32	27.46	28.21	33

TABLE XIX. Amplitudes.

DECLINATION IN DEGREES.

Lat.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23.28
	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.
34°	1.12	2.25	3.37	4.50	6. 2	7.15	8.27	9.40	10.53	12. 5	13.18	14.31	15.45	16.58	18.11	19.25	20.39	21.53	23. 7	24.22	25.37	26.52	28. 7	28.42
35	1.13	2.27	3.40	4.53	6. 6	7.20	8.33	9.47	11. 1	12.14	13.28	14.42	15.56	17.11	18.25	19.40	20.55	22.10	23.25	24.41	25.57	27.13	28.29	29. 5
36	1.14	2.28	3.43	4.57	6.11	7.25	8.40	9.54	11. 9	12.24	13.39	14.54	16. 9	17.24	18.39	19.55	21.11	22.27	23.44	25. 1	26.18	27.35	28.53	29.29
37	1.15	2.30	3.45	5. 1	6.16	7.31	8.47	10. 2	11.18	12.33	13.49	15. 5	16.22	17.38	18.55	20.11	21.28	22.46	24. 3	25.21	26.40	27.58	29.17	29.55
38	1.16	2.32	3.48	5. 5	6.21	7.37	8.54	10.10	11.27	12.44	14. 1	15.18	16.35	17.53	19.10	20.28	21.47	23. 5	24.24	25.43	27. 3	28.23	29.44	30.21
39	1.17	2.34	3.52	5. 9	6.26	7.44	9. 1	10.19	11.37	12.55	14.13	15.31	16.50	18. 8	19.27	20.46	22. 6	23.26	24.46	26. 7	27.28	28.49	30.11	30.49
40	1.18	2.37	3.55	5.13	6.32	7.51	9. 9	10.28	11.47	13. 6	14.25	15.45	17. 5	18.25	19.45	21. 5	22.26	23.47	25. 9	26.31	27.51	29.17	30.40	31.19
41	1.20	2.39	3.59	5.18	6.38	7.58	9.18	10.38	11.58	13.18	14.39	15.59	17.20	18.42	20. 3	21.25	22.48	24.10	25.33	26.57	28.24	29.46	31.11	31.51
42	1.21	2.42	4. 2	5.23	6.44	8. 5	9.26	10.48	12. 9	13.31	14.53	16.15	17.37	19. 0	20.23	21.46	23.10	24.34	25.59	27.24	28.50	30.16	31.43	32.24
43	1.22	2.44	4. 6	5.28	6.51	8.13	9.36	10.58	12.21	13.44	15. 7	16.31	17.55	19.19	20.44	22. 8	23.34	25.00	26.26	27.53	29.20	30.49	32.18	32.59
44	1.23	2.47	4.10	5.34	6.58	8.21	9.45	11. 9	12.34	13.58	15.23	16.48	18.13	19.39	21. 5	22.32	23.59	25.26	26.55	28.23	29.53	31.23	32.54	33.37
45	1.25	2.50	4.15	5.40	7. 5	8.30	9.55	11.21	12.47	14.13	15.39	17. 6	18.33	20.00	21.28	22.57	24.25	25.55	27.25	28.56	30.27	31.59	33.33	34.16
46	1.26	2.53	4.19	5.46	7.12	8.39	10. 6	11.33	13. 1	14.29	15.54	17.25	18.54	20.24	21.53	23.23	24.54	26.25	27.57	29.30	31. 3	32.38	34.14	34.59
47	1.28	2.56	4.24	5.52	7.21	8.49	10.18	11.46	13.16	14.45	16.15	17.45	19.16	20.47	22.18	23.50	25.23	26.57	28.31	30. 6	31.42	33.19	34.57	35.43
48	1.30	2.59	4.29	5.59	7.29	8.50	10.30	12. 0	13.31	15. 2	16.34	18. 6	19.39	21.12	22.45	24.20	25.55	27.30	29. 7	30.44	32.23	34. 3	35.44	36.31
49	1.31	3. 3	4.35	6. 6	7.38	9.10	10.42	12.15	13.48	15.21	16.54	18.29	20. 3	21.38	23.14	24.51	26.29	28. 6	29.45	31.25	33. 7	34.49	36.33	37.22
50	1.33	3. 7	4.40	6.14	7.48	9.22	10.56	12.30	14. 5	15.40	17.16	18.52	20.29	22. 7	23.45	25.24	27. 3	28.44	30.26	32. 9	33.53	35.39	37.26	38.17
51	1.35	3.11	4.46	6.22	7.58	9.34	11.10	12.47	14.24	16. 1	17.39	19.17	20.57	22.36	24.17	25.59	27.41	29.25	31. 9	32.55	34.43	36.32	38.23	39.15
52	1.37	3.15	4.53	6.30	8. 8	9.47	11.25	13. 4	14.43	16.23	18. 3	19.44	21.26	23. 8	24.52	26.36	28.21	30. 8	31.56	33.45	35.36	37.29	39.24	40.18
53	1.40	3.19	4.59	6.39	8.20	10. 0	11.41	13.22	15. 4	16.46	18.29	20.13	21.57	23.42	25.28	27.16	29. 4	30.54	32.45	34.38	36.33	38.30	40.29	41.26
54	1.42	3.24	5. 7	6.49	8.32	10.15	11.58	13.42	15.26	17.11	18.57	20.43	22.30	24.18	26. 7	27.58	29.50	31.49	33.38	35.35	37.34	39.36	41.40	42.39
55	1.45	3.29	5.14	6.59	8.44	10.30	12.16	14. 3	15.50	17.37	19.26	21.15	23. 5	24.57	26.49	28.43	30.39	32.36	34.35	36.36	38.40	40.47	42.56	43.58
56	1.47	3.35	5.22	7.10	8.58	10.46	12.35	14.25	16.15	18. 5	19.57	21.50	23.43	25.38	27.34	29.32	31.31	33.33	35.36	37.42	39.51	42. 4	44.20	45.24
57	1.50	3.40	5.31	7.22	9.13	11. 4	12.56	14.48	16.42	18.36	20.30	22.26	24.24	26.22	28.22	30.24	32.28	34.34	36.43	38.54	41. 9	43.27	45.50	46.59
58	1.53	3.47	5.40	7.34	9.28	11.23	13.18	15.14	17.10	19. 8	21.36	23. 6	25. 7	27.10	29.14	31.21	33.29	35.40	37.54	40.12	42.33	44.59	47.30	48.43
59	1.57	3.53	5.50	7.47	9.45	11.43	13.41	15.41	17.41	19.42	21.45	23.49	25.54	28. 1	30.10	32.21	34.35	36.52	39.12	41.37	44. 6	46.40	49.21	50.32
60	2. 0	4. 0	6. 0	8. 1	10. 2	12. 4	14. 6	16.10	18.14	20.19	22.26	24.34	26.44	28.56	31.10	33.27	35.47	38.10	40.38	43.10	45.47	48.31	51.24	52.47
61	2. 4	4. 8	6.11	8.16	10.21	12.27	14.34	16.41	18.49	20.59	23.11	25.24	27.39	29.56	32.16	34.39	37. 5	39.36	42.11	44.52	47.40	50.36	53.42	55.15
62	2. 8	4.16	6.24	8.33	10.42	12.52	15. 3	17.15	19.28	21.42	23.59	26.17	28.38	31. 1	33.27	35.57	38.31	41.10	43.54	46.46	49.46	52.56	56.20	58. 1
63	2.12	4.25	6.37	8.50	11. 4	13.19	15.34	17.51	20. 9	22.29	24.51	27.15	29.42	32.12	34.45	37.23	40. 5	42.54	45.49	48.53	52. 8	55.36	59.23	61.18
64	2.17	4.34	6.51	9. 9	11.28	13.48	16. 8	18.31	20.54	23.20	25.48	28.19	30.52	33.30	36.11	38.58	41.50	44.49	47.58	51.17	54.50	58.43	63. 2	65.17
65	2.22	4.44	7. 7	9.30	11.54	14.19	16.46	19.14	21.44	24.16	26.50	29.28	32.10	34.55	37.46	40.43	43.48	46.59	50.23	54. 2	57.59	62.25	67.36	69.26
66	2.28	4.55	7.24	9.53	12.22	14.54	17.26	20. 1	22.37	25.16	27.59	30.45	33.35	36.30	39.31	42.40	45.57	49.27	53.10	57.14	61.46	67. 4	73.52	78.15

A TABLE showing the Time of the Sun, Moon, and stars setting; when the Latitude and Declination are of the same Name; and the Time of its rising, when the Latitude and Declination are of different Names.

TABLE XX.

Lat.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23.28	Lat.
	Degrees of Declination.																									
	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	
1°	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.02	6.02	6.02	6.02	1°
2	6.00	6.00	6.00	6.00	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.02	6.02	0.02	6.02	6.02	6.02	6.02	6.03	6.03	6.03	6.03	6.03	6.03	6.03	2
3	6.00	6.00	6.00	6.01	6.01	6.01	6.01	6.01	6.02	6.02	6.02	6.02	6.03	6.03	6.03	6.03	6.03	6.04	6.04	6.04	6.04	6.05	6.05	6.05	6.05	3
4	6.00	6.00	6.01	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.03	6.04	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.06	6.06	6.07	6.07	4
5	6.00	6.00	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.04	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.07	6.08	6.08	6.09	6.09	5
6	6.00	6.00	6.01	6.01	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.06	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09	6.10	6.10	6.10	6
7	6.00	6.00	6.01	6.01	6.02	6.02	6.03	6.03	6.04	6.04	6.05	6.05	6.06	6.06	6.07	6.08	6.08	6.09	6.09	6.10	6.10	6.11	6.11	6.12	6.12	7
8	6.00	6.01	6.01	6.02	6.02	6.03	6.03	6.04	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.09	6.09	6.10	6.10	6.11	6.12	6.12	6.13	6.14	6.14	8
9	6.00	6.01	6.01	6.02	6.03	6.03	6.04	6.04	6.05	6.06	6.06	6.07	6.08	6.08	6.09	6.10	6.10	6.11	6.12	6.13	6.13	6.14	6.15	6.15	6.16	9
10	6.00	6.01	6.01	6.02	6.03	6.04	6.04	6.05	6.06	6.06	6.07	6.08	6.09	6.09	6.10	6.11	6.12	6.12	6.13	6.14	6.15	6.16	6.16	6.17	6.18	10
11	6.00	6.01	6.02	6.02	6.03	6.04	6.05	6.05	6.06	6.07	6.08	6.09	6.09	6.10	6.11	6.12	6.13	6.14	6.14	6.15	6.16	6.17	6.18	6.19	6.19	11
12	6.00	6.01	6.02	6.03	6.03	6.04	6.05	6.06	6.07	6.08	6.09	6.09	6.10	6.11	6.12	6.13	6.14	6.15	6.16	6.17	6.18	6.19	6.20	6.21	6.21	12
13	6.00	6.01	6.02	6.93	6.04	6.05	6.06	6.06	6.07	6.08	6.09	6.10	6.11	6.12	6.13	6.14	6.15	6.16	6.17	6.18	6.19	6.20	6.21	6.22	6.23	13
14	6.00	6.01	6.02	6.03	6.04	6.05	6.06	6.07	6.08	6.09	6.10	6.11	6.12	6.13	6.14	6.15	6.16	6.17	6.19	6.20	6.21	6.22	6.23	6.24	6.25	14
15	6.00	6.01	6.02	6.03	6.04	6.05	6.06	6.08	6.09	6.10	6.11	6.12	6.13	6.14	6.15	6.16	6.18	6.19	6.20	6.21	6.22	6.24	6.25	6.26	6.27	15
16	6.00	6.01	6.02	6.03	6.05	6.06	6.07	6.08	6.09	6.10	6.12	6.13	6.14	6.15	6.16	6.18	6.19	6.20	6.21	6.23	6.24	6.25	6.27	6.28	6.29	16
17	6.00	6.01	6.02	6.04	6.05	6.06	6.07	6.09	6.10	6.11	6.12	6.14	6.15	6.16	6.17	6.19	6.20	6.21	6.23	6.24	6.26	6.27	6.28	6.30	6.31	17
18	6.00	6.01	6.03	6.04	6.05	6.07	6.08	6.09	6.10	6.12	6.13	6.14	6.16	6.17	6.19	6.20	6.21	6.23	6.24	6.26	6.27	6.29	6.30	6.32	6.32	18
19	6.00	6.01	6.03	6.04	6.06	6.07	6.08	6.10	6.11	6.13	6.14	6.15	6.17	6.18	6.20	6.21	6.23	6.24	6.26	6.27	6.29	6.30	6.32	6.34	6.34	19
20	6.00	6.01	6.03	6.04	6.06	6.07	6.09	6.10	6.12	6.13	6.15	6.16	6.18	6.19	6.21	6.22	6.24	6.26	6.27	6.29	6.30	6.32	6.34	6.36	6.36	20
21	6.00	6.02	6.03	6.05	6.06	6.08	6.09	6.11	6.12	6.14	6.16	6.17	6.19	6.20	6.22	6.24	6.25	6.27	6.29	6.30	6.32	6.34	6.36	6.38	6.38	21
22	6.00	6.02	6.03	6.05	6.06	6.08	6.10	6.11	6.13	6.15	6.16	6.18	6.20	6.21	6.23	6.25	6.27	6.28	6.30	6.32	6.34	6.36	6.38	6.39	6.40	22
23	6.00	6.02	6.03	6.05	6.07	6.09	6.10	6.12	6.14	6.15	6.17	6.19	6.21	6.22	6.24	6.26	6.28	6.30	6.32	6.34	6.36	6.38	6.39	6.42	6.42	23
24	6.00	6.02	6.04	6.05	6.07	6.09	6.11	6.13	6.14	6.16	6.18	6.20	6.22	6.24	6.25	6.27	6.29	6.31	6.33	6.35	6.37	6.39	6.41	6.44	6.45	24
25	6.00	6.02	6.04	6.06	6.07	6.09	6.11	6.13	6.15	6.17	6.19	6.21	6.23	6.25	6.27	6.29	6.31	6.33	6.35	6.37	6.39	6.41	6.43	6.46	6.47	25
26	6.00	6.02	6.04	6.06	6.08	6.10	6.12	6.14	6.16	6.18	6.20	6.22	6.24	6.26	6.28	6.30	6.32	6.34	6.36	6.39	6.41	6.43	6.45	6.48	6.49	26
27	6.00	6.02	6.04	6.06	6.08	6.10	6.12	6.14	6.16	6.19	6.21	6.23	6.25	0.27	6.29	6.31	6.34	6.36	6.38	6.40	6.43	6.45	6.48	6.50	6.51	27
28	6.00	6.02	6.04	6.06	6.09	6.11	6.13	6.15	6.17	6.19	6.22	6.24	6.26	6.28	6.30	6.33	6.35	6.37	6.40	6.42	6.45	6.47	6.50	6.52	6.53	28
29	6.00	6.02	6.04	6.07	6.09	6.11	6.13	6.16	6.18	6.20	6.22	6.25	6.27	6.29	6.32	6.34	6.37	6.39	6.42	6.44	6.47	6.49	6.52	6.54	6.56	29
30	6.00	6.02	6.05	6.07	6.09	6.12	6.14	6.16	6.19	6.21	6.23	6.26	6.28	6.31	6.33	6.36	6.38	6.41	6.43	6.46	6.49	6.51	6.54	6.57	6.58	30

A TABLE showing the Time of the Sun, Moon, and Star's setting, when the Latitude and Declination are of the same Name and the Time of its rising, when the Latitude and Declination are of different Names.

DEGREES OF DECLINATION.

Lat.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23 28	Lat.
	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	
31°	6.00	6.02	6.05	6.07	6.10	6.12	6.14	6.17	6.19	6.22	6.24	6.27	6.29	6.32	6.34	6.37	6.40	6.42	6.45	6.48	6.51	6.53	6.56	6.59	7.00	31°
32	6.00	6.02	6.05	6.08	6.10	6.13	6.15	6.18	6.20	6.23	6.25	6.28	6.31	6.33	6.36	6.39	6.41	6.44	6.47	6.50	6.53	6.56	6.58	7.02	7.03	32
33	6.00	4.03	6.05	6.08	6.10	6.13	6.16	6.18	6.21	6.24	6.26	6.29	6.32	6.34	6.37	6.40	6.43	6.46	6.49	6.52	6.55	6.58	7.01	7.04	7.05	33
34	6.00	6.03	6.05	6.08	6.11	6.14	6.16	6.19	6.22	6.25	6.27	6.30	6.33	6.36	6.39	6.42	6.45	6.48	6.51	6.54	6.57	7.00	7.03	7.07	7.08	34
35	6.00	6.03	6.06	6.08	6.11	6.14	6.17	6.20	6.23	6.25	6.28	6.31	6.34	6.37	6.40	6.43	6.46	6.49	6.53	6.56	6.59	7.02	7.06	7.09	7.11	35
36	6.00	6.03	6.06	6.09	6.12	6.15	6.18	6.20	6.23	6.26	6.29	6.32	6.36	6.39	6.42	6.45	6.48	6.51	6.55	6.58	7.01	7.05	7.08	7.12	7.14	36
37	6.00	6.03	6.06	6.09	6.12	6.15	6.18	6.21	6.24	6.27	6.31	6.34	6.37	6.40	6.43	6.47	6.50	6.53	6.57	7.00	7.04	7.07	7.11	7.15	7.16	37
38	6.00	6.03	6.06	6.09	6.13	6.16	6.19	6.22	6.25	6.28	0.32	6.35	6.38	6.42	6.45	6.48	6.52	6.55	6.59	7.02	7.06	7.10	7.14	7.17	7.19	58
39	6.00	6.03	6.06	6.10	6.13	6.16	6.20	6.23	6.26	6.29	6.33	6.36	6.40	6.43	6.47	6.50	6.54	6.57	7.01	7.05	7.09	7.12	7.16	7.20	7.22	39
40	6.00	6.03	6.07	6.10	6.13	6.17	6.20	6.24	6.27	6.31	6.34	6.38	6.41	6.45	6.48	6.52	6.56	6.59	7.03	7.07	7.11	7.15	7.19	7.23	7.25	40
41	6.00	6.03	6.97	6.10	6.14	6.17	6.21	6.25	6.28	6.32	6.35	6.39	6.43	6.46	6.50	6.54	6.58	7.02	7.06	7.10	7.14	7.18	7.22	7.27	7.29	41
42	6.00	6.04	6.07	6.11	6.14	6.18	6.22	6.25	6.29	6.33	6.37	6.40	6.44	6.48	6.52	6.56	7.00	7.04	7.08	7.12	7.17	7.21	7.25	7.30	7.32	42
43	6.00	6.04	6.07	6.11	6.15	6.19	6.22	6.26	6.30	6.34	6.38	6.42	6.46	6.50	6.54	6.58	7.02	7.06	7.11	7.15	7.19	7.24	7.29	7.33	7.36	43
44	6.00	6.04	6.08	6.12	6.15	6.19	6.23	6.27	6.31	6.35	6.39	6.43	6.47	6.52	6.56	7.00	7.04	7.09	7.13	7.18	7.22	7.27	7.32	7.37	7.39	44
45	6.00	6.04	6.08	6.12	6.16	6.20	6.24	6.28	6.32	6.36	6.41	6.45	6.49	6.53	6.58	7.02	7.07	7.11	7.16	4.21	7.25	7.30	7.35	7.40	7.43	45
46	6.00	6.04	6.08	6.12	6.17	6.21	6.25	6.29	6.33	6.38	6.42	6.46	6.51	6.55	7.00	7.04	7.09	7.14	7.19	7.24	7.29	7.34	7.39	7.44	7.47	46
47	6.00	6.04	6.09	6.13	6.17	6.22	6.26	6.30	6.35	6.39	6.44	6.48	6.53	6.57	7.02	7.07	7.12	7.17	7.22	7.27	7.32	7.37	7.43	7.48	7.51	47
48	6.00	6.04	6.09	6.13	6.18	6.22	6.27	6.31	6.36	6.41	6.45	6.50	6.55	6.59	7.04	7.09	7.14	7.19	7.25	7.30	7.35	7.41	7.47	7.53	7.55	48
49	6.00	6.05	6.09	6.14	6.18	6.23	6.28	6.32	6.37	6.42	6.47	6.52	6.57	7.02	7.07	7.12	7.17	7.22	7.28	7.33	7.39	7.45	7.51	7.57	8.00	49
50	6.00	6.05	6.10	6.14	6.19	6.24	6.29	6.34	6.39	6.44	6.49	6.54	6.59	7.04	7.09	7.14	7.20	7.25	7.31	7.37	7.43	7.49	7.55	8.02	8.05	50
51	6.00	6.05	6.10	6.15	6.20	6.25	6.30	6.35	6.40	6.45	6.50	6.56	7.01	7.06	7.12	7.17	7.23	7.29	7.35	7.41	7.47	7.53	8.00	8.06	8.10	51
52	6.00	6.05	6.10	6.15	6.21	6.26	6.31	6.36	6.41	6.47	6.52	6.58	7.03	7.09	7.14	7.20	7.26	7.32	7.38	7.45	7.51	7.58	8.05	8.12	8.15	52
53	6.00	6.05	6.11	6.16	6.21	6.27	6.32	6.38	6.43	6.49	6.54	7.00	7.06	7.11	7.17	7.23	7.29	7.36	7.42	7.49	7.56	8.02	8.10	8.17	8.21	53
54	6.00	6.06	6.11	6.17	6.22	6.28	6.33	6.39	6.45	6.50	6.56	7.02	7.08	7.14	7.20	7.27	7.33	7.40	7.46	7.53	8.00	8.08	8.15	8.23	8.27	54
55	6.00	6.06	6.11	6.17	6.23	6.29	6.35	6.40	6.46	6.52	6.58	7.04	7.11	7.17	7.23	7.30	7.37	7.44	7.51	7.58	8.05	8.13	8.21	8.29	8.33	55
56	6.00	6.06	6.12	6.18	6.24	6.30	6.36	6.42	6.48	6.54	7.01	7.07	7.13	7.20	7.27	7.34	7.41	7.48	7.55	8.03	8.11	8.19	8.27	8.36	8.40	56
57	6.00	6.06	6.12	6.19	6.25	6.31	6.37	6.44	6.50	6.56	7.03	7.10	7.16	7.23	7.30	7.37	7.45	7.52	8.00	8.08	8.16	8.25	8.34	8.43	8.48	57
58	6.00	6.06	6.13	6.19	6.26	6.32	6.39	6.45	6.52	6.59	7.06	7.12	7.20	7.27	7.34	7.42	7.49	7.57	8.05	8.14	8.22	8.32	8.41	8.51	8.56	58
59	6.00	6.07	6.13	6.20	6.27	6.33	6.40	6.47	6.54	7.01	7.08	7.15	7.23	7.30	7.38	7.46	7.54	8.02	8.11	8.20	8.29	8.39	8.49	9.00	9.05	59
60	6.00	6.07	6.14	6.21	6.28	6.35	6.42	6.49	6.56	7.04	7.11	7.19	7.26	7.34	7.42	7.51	7.59	8.08	8.17	8.26	8.36	8.47	8.58	9.09	9.15	60

TABLE XXI.

For Finding the Distance of Terrestrial Objects at Sea.

Ht. Ft.	Dist. M. D.	Ht. Ft.	Dist. M. D.	Ht. Ft.	Dist. M. D.	Ht. Ft.	Dist. M. D.
1	1. 32	44	8. 78	320	23. 67	1000	41. 8
2	1. 87	45	8. 87	330	24. 03	1100	43. 9
3	2. 29	46	8. 97	340	24. 39	1200	45. 8
4	2. 65	47	9. 07	350	24. 75	1300	47. 7
5	2. 96	48	9. 17	360	25. 10	1400	49. 5
6	3. 24	49	9. 26	370	25. 45	1500	51. 2
7	3. 50	50	9. 35	380	25. 79	1600	52. 9
8	3. 74	55	9. 81	390	26. 13	1700	54. 5
9	3. 97	60	10. 25	400	26. 46	1800	56. 1
10	4. 18	65	10. 67	410	26. 79	1900	57. 7
11	4. 39	70	11. 07	420	27. 11	2000	59. 2
12	4. 58	75	11. 46	430	27. 43	2100	60. 6
13	4. 77	80	11. 83	440	27. 75	2200	62. 1
14	4. 95	85	12. 20	450	28. 06	2300	63. 4
15	5. 12	90	12. 55	460	28. 37	2400	64. 8
16	5. 29	95	12. 89	470	28. 68	2500	66. 1
17	5. 45	100	13. 23	480	28. 98	2600	67. 5
18	5. 61	105	13. 56	490	29. 29	2700	68. 7
19	5. 77	110	13. 88	500	29. 58	2800	70. 0
20	5. 92	115	14. 19	520	30. 17	2900	71. 2
21	6. 06	120	14. 49	540	30. 74	3000	72. 5
22	6. 21	125	14. 79	560	31. 31	3100	73. 7
23	6. 34	130	15. 08	580	31. 86	3200	74. 8
24	6. 48	135	15. 37	600	32. 41	3300	76. 0
25	6. 61	140	15. 65	620	32. 94	3400	77. 1
26	6. 75	145	15. 93	640	33. 47	3500	78. 3
27	6. 87	150	16. 20	660	33. 99	3600	79. 4
28	7. 00	160	16. 73	680	34. 50	3700	80. 5
29	7. 12	170	17. 25	700	35. 00	3800	81. 6
30	7. 25	180	17. 75	720	35. 50	3900	82. 6
31	7. 37	190	18. 24	740	35. 99	4000	83. 7
32	7. 48	200	18. 71	760	36. 47	4100	84. 7
33	7. 60	210	19. 17	780	36. 95	4200	85. 7
34	7. 71	220	19. 62	800	37. 42	4300	86. 8
35	7. 83	230	20. 06	820	37. 88	4400	87. 8
36	7. 94	240	20. 50	840	38. 34	4500	88. 7
37	8. 05	250	20. 92	860	38. 80	4600	89. 7
38	8. 16	260	21. 33	880	39. 25	4700	90. 7
39	8. 26	270	21. 74	900	39. 69	4800	91. 7
40	8. 37	280	22. 14	920	40. 13	4900	92. 6
41	8. 47	290	22. 53	940	40. 56	5000	93. 5
42	8. 57	300	22. 91	960	40. 99		
43	8. 68	310	23. 29	980	41. 42	1 M.	96. 1

TABLE XXII.

Proportion of Powder for Sea-Guns.

Pdrs.	Proof.	Service.	Saluting.	Scaling.
	lb. oz.	lb. oz.	lb. oz.	lb. oz.
42	25. 0	14. 0	10. 0	3. 0
32	21. 0	10. 11	8. 0	2. 12
24	18. 0	8. 0	6. 0	2. 0
18	15. 0	6. 0	4. 8	1. 8
12	12. 0	4. 0	3. 0	1. 0
9	9. 0	3. 0	2. 4	0. 12
6	6. 0	2. 0	2. 0	0. 8
4	4. 0	1. 5	1. 5	0. 6
3	3. 0	1. 0	1. 0	0. 4
½	0. 8	0. 3	0. 3	0. 1
Caronades.				
42	9. 0	4. 8	4. 8	1. 8
32	8. 0	4. 0	4. 0	1. 4
24	6 0	3. 0	3. 0	1. 0
18	4. 0	2. 0	2. 0	1. 0
12	3. 0	1. 8	1. 8	0. 12
Wall Pieces.				
	2. 8	0. 10		
Musquets.				
	0. 12	0. 6		
Pistols.				
	0. 6	0. 3		

N. B. These proportions are with powder in good condition; if it is damp, or damaged, a greater quantity will be necessary.

A TABLE of the Number and sorts of Shot contained in the Grapes for the nature of Guns undermentioned.

Pdrs.	Shot.	No. in each.	No. in each box.
42	4lb.	9	4
32	3	9	4
24	2	9	6
18	1½	9	8
12	1	9	10
	Oz.		
9	13	9	12
6	8	9	20
4	6	9	20

TABLE XXIII. For finding the Latitude by two Altitudes of the Sun.

Half elapsed Time.

	0 Hour.							1 Hour.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0		13833	83730	66121	53627	43936	0	0.58700	58582	58465	58348	58231	58115
1	2.36018	29324	23525	18409	13834	09695	1	57999	57883	57768	57653	57538	57424
2	05916	02440	99221	96225	93422	90790	2	57310	57196	57083	56970	56857	56745
3	1.88307	85959	83732	81613	79593	77663	3	56633	56521	56409	56298	56187	56076
4	75814	74042	72339	70700	69121	67597	4	55966	55856	55746	55637	55528	55419
5	66125	64701	63322	61986	60690	59431	5	55311	55203	55095	54987	54880	54773
6	58208	57018	55861	54733	53634	52561	6	54666	54559	54453	54347	54241	54136
7	51515	50494	49496	48520	47566	46632	7	54031	53926	53822	53718	53614	53510
8	45718	44823	43946	43086	42243	41417	8	53406	53303	53200	53097	52995	52893
9	40605	39809	39027	38258	37503	36762	9	52791	52690	52589	52488	52387	52286
10	1.36082	35315	34609	33915	33231	32558	10	0.52186	52086	51986	51886	51787	51688
11	31896	31243	30600	29967	29342	28727	11	51589	51490	51392	51294	51196	51099
12	28120	27522	26931	26349	25774	25207	12	51002	50905	50808	50711	50615	50519
13	24647	24095	23549	23010	22477	21952	13	50423	50327	50232	50137	50042	49947
14	21432	20919	20412	19910	19415	18925	14	49852	49758	49664	49570	49476	49383
15	18440	17961	17487	17018	16554	16096	15	49290	49197	49104	49012	48920	48828
16	15642	15192	14748	14307	13872	13440	16	48736	48644	48553	48462	48371	48280
17	13013	12590	12171	11757	11346	10939	17	48189	48099	48009	47919	47829	47739
18	10536	10136	09740	09348	08960	08575	18	47650	47561	47472	47383	47295	47207
19	08193	07814	07439	07067	06698	06333	19	47119	47031	46943	46856	46769	46682
20	1.05970	05610	05254	04901	04550	04202	20	0.46595	46508	46421	46335	46249	46163
21	03857	03515	03175	02838	02504	02172	21	46077	45992	45907	45822	45737	45652
22	01843	01516	01192	00870	00550	00233	22	45567	45483	45399	45315	45231	45147
23	0.99918	99606	99296	98988	98682	98378	23	45064	44981	44898	44815	44732	44649
24	98077	97777	97480	97184	96891	96600	24	44567	44485	44403	44321	44239	44158
25	96310	96023	95738	95454	95172	94892	25	44077	43996	43915	43834	43753	43673
26	94614	94338	94063	93790	93519	93250	26	43593	43513	43433	43353	43273	43193
27	92982	92716	92452	92189	91928	91669	27	43114	43035	42956	42877	42799	42721
28	91411	94154	90899	90646	90394	90143	28	42643	42565	42487	42409	42331	42253
29	89894	89647	89401	89156	88913	88671	29	42176	42099	42022	41945	41868	41792
30	0.88430	88191	87953	87717	87481	87247	30	0.41716	41640	41564	41488	41412	41336
31	87015	86783	86553	86324	86096	85870	31	41261	41186	41111	41036	40961	40886
32	85644	85420	85197	84976	84755	84535	32	40812	40738	40664	40590	40516	40442
33	84317	84100	83884	83669	83455	83242	33	40368	40295	40222	40149	40076	40003
34	83030	82819	82609	82401	82193	81986	34	39930	39857	39785	39713	39641	39569
35	81780	81576	81372	81169	80967	80767	35	39497	39425	39353	39282	39211	39140
36	80567	80368	80170	79973	79777	79581	36	39069	38998	38927	38856	38786	38716
37	79387	79193	79001	78809	78618	78428	37	38646	38576	38506	38436	38366	38296
38	78239	78051	77863	77677	77491	77306	38	38227	38158	38089	38020	37951	37882
39	77122	76938	76756	76574	76393	76212	39	37813	37745	37677	37609	37541	37473
40	0.76033	75854	75676	75499	75323	75147	40	0.37405	37337	37269	37202	37135	37068
41	74972	74797	74624	74451	74279	74107	41	37001	36934	36867	36800	36734	36668
42	73937	73767	73597	73429	73261	73093	42	36602	36536	36470	36404	36338	36272
43	72926	72760	72595	72430	72266	72103	43	36206	36141	36076	36011	35946	35881
44	71940	71778	71616	71455	71295	71135	44	35816	35751	35686	35622	35558	35494
45	70976	70818	70660	70503	70346	70190	45	35430	35366	35302	35238	35174	35110
46	70034	69879	69725	69571	69418	69265	46	35047	34984	34921	34858	34795	34732
47	69113	68962	68811	68660	68510	68361	47	34669	34606	34544	34483	34420	34358
48	68212	68064	67916	67769	67622	67476	48	34296	34234	34172	34110	34048	33986
49	67330	67185	67040	66896	66752	66609	49	33925	33864	33803	33742	33681	33620
50	0.66466	66324	66182	66041	65900	65760	50	0.33559	33498	33438	33378	33318	33258
51	65620	65481	65342	65204	65066	64928	51	33197	33137	33077	33017	32958	32899
52	64791	64655	64519	64383	64248	64113	52	32839	32780	32720	32661	32602	32543
53	63978	63844	63711	63578	63445	63313	53	32485	32426	32367	32309	32250	32192
54	63181	63050	62919	62789	62659	62529	54	32134	32076	32018	31960	31902	31844
55	62400	62271	62142	62014	61886	61759	55	31787	31729	31672	31614	31557	31500
56	61632	61506	61380	61254	61129	61004	56	31443	31386	31329	31272	31216	31159
57	60879	60755	60631	60508	60385	60262	57	31103	31046	30990	30934	30878	30822
58	60140	60018	59896	59775	59654	59534	58	30766	30710	30655	30599	30544	30488
59	59414	59294	59175	59056	58937	58818	59	30423	30378	30323	30268	30213	30158

Half Elapsed Time.

	2 Hours.							3 Hours.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0	0.30103	30048	29994	29939	29885	29831	0	0.15051	15020	14988	14957	14926	14894
1	29776	29722	29668	29614	29560	29507	1	14863	14832	14800	14769	14738	14707
2	29453	29399	29346	29293	29239	29186	2	14676	14645	14614	14583	14552	14521
3	29133	29080	29027	28974	28921	28869	3	14490	14460	14429	14398	14368	14337
4	28816	28764	28711	28659	28607	28554	4	14307	14276	14246	14215	14185	14155
5	28502	28450	28398	28346	28295	28243	5	14124	14094	14064	14034	14004	13974
6	28191	28140	28089	28037	27986	27935	6	13944	13914	13884	13854	13824	13794
7	27884	27833	27782	27731	27680	27630	7	13765	13735	13705	13676	13646	13617
8	27579	27529	27478	27428	27378	27327	8	13587	13558	13528	13499	13470	13441
9	27277	27227	27177	27127	27077	27028	9	13411	13382	13353	13324	13295	13266
10	0.26978	26929	26879	26830	26781	26731	10	0.13237	13208	13179	13150	13121	13093
11	26682	26633	26584	26535	26486	26438	11	13064	13035	13007	12978	12950	12921
12	26389	26340	26292	26244	26195	26147	12	12893	12864	12835	12807	12779	12751
13	26099	26051	26003	25955	25907	25859	13	12723	12695	12666	12638	12610	12582
14	25811	25763	25716	25668	25621	25573	14	12554	12526	12499	12471	12443	12415
15	25526	25479	25432	25385	25338	25291	15	12387	12360	12332	12305	12277	12249
16	25244	25197	25150	25104	25057	25011	16	12222	12195	12167	12140	12113	12085
17	24964	24918	24872	24825	24779	24733	17	12058	12031	12004	11977	11949	11922
18	24687	24641	24595	24550	24504	24458	18	11895	11868	11842	11815	11788	11761
19	24413	24367	24322	24276	24231	24186	19	11734	11708	11681	11654	11628	11601
20	0.24141	24096	24051	24006	23961	23916	20	0.11575	11548	11522	11495	11469	11443
21	23871	23827	23782	23738	23693	23649	21	11416	11390	11364	11333	11312	11285
22	23605	23560	23516	23472	23428	23384	22	11259	11233	11207	11181	11155	11130
23	23340	23296	23252	23209	23165	23122	23	11104	11078	11052	11027	11001	10975
24	23078	23035	22991	22948	22905	22862	24	10950	10924	10899	10873	10848	10822
25	22819	22775	22732	22690	22647	22604	25	10797	10772	10746	10721	10696	10671
26	22561	22519	22476	22433	22391	22349	26	10646	10620	10595	10570	10545	10520
27	22306	22264	22222	22180	22138	22096	27	10495	10471	10446	10421	10396	10371
28	22054	22012	21970	21928	21887	21845	28	10347	10322	10297	10272	10248	10224
29	21803	21762	21720	21679	21638	21596	29	10199	10175	10151	10126	10102	10078
30	0.21555	21514	21473	21432	21391	21350	30	0.10053	10029	10005	09981	09957	09933
31	21309	21269	21228	21187	21147	21106	31	09909	09885	09861	09837	09813	09789
32	21066	21025	20985	20945	20905	20864	32	09765	09741	09718	09694	09670	09647
33	20824	20784	20744	20704	20665	20625	33	09623	09599	09576	09552	09529	09506
34	20585	20545	20506	20466	20427	20387	34	09482	09459	09435	09412	09389	09366
35	20348	20309	20269	20230	20191	20152	35	09343	09319	09296	09273	09250	09227
36	20113	20074	20035	19996	19957	19919	36	09204	09181	09158	09136	09113	09090
37	19880	19841	19803	19764	19726	19687	37	09067	09044	09022	08999	08976	08954
38	19649	19611	19572	19534	19496	19458	38	08931	08909	08886	08864	08842	08819
39	19420	19382	19344	19306	19269	19231	39	08797	08774	08752	08730	08708	08686
40	0.19193	19156	19118	19081	19043	19006	40	0.08664	08641	08619	08597	08575	08553
41	18968	18931	18894	18857	18820	18783	41	08531	08510	08488	08466	08444	08422
42	18746	18709	18672	18635	18598	18561	42	08401	08379	03357	08336	08314	08293
43	18525	18488	18451	18415	18378	18342	43	08271	08250	08228	08207	08185	08164
44	18306	18269	18233	18197	18161	18124	44	08143	08121	08100	08079	08058	08036
45	18089	18053	18017	17981	17945	17909	45	08015	07994	07973	07952	07931	07910
46	17874	17838	17802	17767	17731	17696	46	07889	07868	07848	07827	07806	07785
47	17660	17625	17590	17554	17519	17484	47	07765	07744	07723	07703	07682	07661
48	17449	17414	17379	17344	17309	17274	48	07641	07620	07600	07579	07559	07539
49	17239	17205	17170	17135	17101	17066	49	07518	07498	07478	07458	07437	07417
50	0.17032	16997	16963	16928	16894	16860	50	0.07397	07377	07357	07337	07317	07297
51	16826	16792	16758	16724	16690	16656	51	07277	07257	07237	07217	07197	07178
52	16622	16588	16554	16520	16487	16453	52	07158	07138	07119	07099	07079	07060
53	16419	16386	16352	16319	16285	16252	53	07040	07021	07001	06982	06962	06943
54	16219	16186	16152	16119	16086	16053	54	06923	06904	06885	06865	06846	06827
55	16020	15987	15954	15920	15888	15856	55	06808	06789	06770	06751	06731	06712
56	15823	15790	15758	15725	15692	15660	56	06693	06674	06656	06637	06618	06599
57	15628	15595	15563	15530	15498	15466	57	06580	06561	06543	06524	06505	06487
58	15434	15402	15370	15338	15306	15274	58	06462	06449	06431	06412	06394	06375
59	15242	15210	15178	15146	15115	15083	59	06357	06338	06320	[illegible]	[illegible]	[illegible]

TABLE XXIII. For finding the Latitude by two Altitudes of the Sun.

Half Elapsed Time.

	4 Hours.							5 Hours.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0	0.06247	06229	06211	06192	06174	06156	0	0.01506	01497	01489	01480	01472	01464
1	06138	06120	06102	06084	06066	06048	1	01455	01447	01439	01430	01422	01414
2	06030	06012	05995	05977	05959	05941	2	01406	01398	01390	01381	91373	01365
3	05924	05906	05888	05871	05853	05836	3	01357	01349	01341	01333	01325	01317
4	05818	05801	05783	05766	05748	05731	4	01310	01302	01294	01286	01278	01270
5	05714	05696	05679	05662	05645	05627	5	01263	01255	01247	01240	01232	01224
6	05610	05593	05576	05559	05542	05525	6	01217	01209	01202	01194	01187	01179
7	05508	05491	05474	05457	05440	05423	7	01172	01164	01157	01150	01142	01135
8	05406	05389	05373	05356	05340	05323	8	01128	01120	01113	01106	01099	01091
9	05306	05290	05273	05257	05240	05224	9	01084	01077	01070	01063	01056	01049
10	0.05207	05191	05174	05158	05142	05125	10	0.01042	01035	01028	01021	01014	01007
11	05109	05093	05076	05060	05044	05028	11	01000	00993	00987	00980	00973	00966
12	05012	04996	04980	04964	04948	04932	12	00960	00953	00946	00940	00933	00926
13	04916	04900	04884	04868	04852	04837	13	00920	00913	00907	00900	00894	00887
14	04821	04805	04789	04774	04758	04743	14	00881	00874	00868	00862	00855	00849
15	04727	04711	04696	04680	04665	04649	15	00843	00836	00830	00824	00818	00811
16	04634	04619	04603	04588	04573	04557	16	00805	00799	00793	00787	00781	00775
17	04542	04527	04512	04496	04481	04466	17	00769	00763	00757	00751	00745	00739
18	04451	04436	04421	04406	04391	04376	18	00733	00728	00721	00716	00710	00704
19	04361	04346	04332	04317	04302	04287	19	00699	00693	00687	00682	00676	00670
20	0.04272	04258	04243	04228	04214	04199	20	0.00665	00659	00654	00648	00643	00637
21	04185	04170	04155	04141	04127	04112	21	00632	00626	00621	00616	00610	00605
22	04098	04083	04069	04055	04040	04026	22	00600	00594	00589	00584	00579	00574
23	04012	03998	03983	03969	03955	03941	23	00568	00563	00558	00553	00548	00543
24	03927	03913	03899	03885	03871	03857	24	00538	00533	00528	00523	00518	00513
25	03843	03829	03815	03802	03788	03774	25	00508	00504	00499	00494	00489	00484
26	03760	03746	03733	03719	03706	03692	26	00480	00475	00470	00466	00461	00456
27	03678	03665	03651	03638	03624	03611	27	00452	00447	00443	00438	00434	00429
28	03597	03584	03571	03557	03544	03531	28	00425	00420	00416	00412	00407	00403
29	03517	03504	03491	03478	03465	03452	29	00399	00394	00390	00386	00382	00377
30	0.03438	03425	03412	03399	03386	03373	30	0.00373	00369	00365	00361	00357	00353
31	03360	03348	03335	03322	03309	03296	31	00349	00345	00341	00337	00333	00329
32	03283	03271	03258	03245	03233	03220	32	00325	00321	00317	00313	00310	00306
33	03207	03195	03182	03170	03157	03145	33	00302	00298	00295	00291	00287	00284
34	03132	03120	03107	03095	03083	03070	34	00280	00276	00273	00269	00266	00262
35	03058	03046	03034	03021	03009	02997	35	00259	00255	00252	00249	00245	00242
36	02985	02973	02961	02949	02937	02925	36	00239	00235	00232	00229	00225	00222
37	02913	02901	02889	02877	02865	02853	37	00219	00216	00213	00210	00207	00203
38	02841	02829	02818	02806	02794	02783	38	00200	00197	00194	00191	00188	00185
39	02771	02759	02748	02736	02724	02713	39	00183	00180	00177	00174	00171	00168
40	0.02701	02690	02678	02667	02656	02644	40	0.00166	00163	00160	00157	00155	00152
41	02633	02622	02610	02599	02588	02577	41	00149	00147	00144	00142	00139	00137
42	02565	02554	02543	02532	02521	02510	42	00134	00132	00129	00127	00124	00122
43	02499	02488	02477	02466	02455	02444	43	00120	00117	00115	00113	00110	00108
44	02433	02422	02411	02400	02390	02379	44	00106	00104	00102	00099	00097	00095
45	02368	02357	02347	02336	02326	02315	45	00093	00091	00089	00087	00085	00083
46	02304	02294	02283	02273	02262	02252	46	00081	00079	00077	00075	00074	00072
47	02241	02231	02221	02210	02200	02190	47	00070	00068	00066	00065	00063	00061
48	02179	02169	02159	02149	02139	02128	48	00060	00058	00056	00055	00053	00052
49	02118	02108	02098	02088	02078	02068	49	00050	00049	00047	00046	00044	00043
50	0.02058	02048	02038	02028	02018	02009	50	0.00041	00040	00039	00037	00036	00035
51	01999	01989	01979	01969	01960	01950	51	00033	00032	00031	00030	00029	00028
52	01940	01331	01921	01912	01902	01892	52	00026	00025	00024	00023	00022	00021
53	01883	01873	01864	01854	01845	01836	53	00020	00019	00018	00017	00017	00016
54	01826	01817	01808	01798	01789	01780	54	00015	00014	00013	00013	00012	00011
55	01771	01761	01752	01743	01734	01725	55	00010	00010	00009	00008	00008	00007
56	01716	01707	01698	01689	01680	01671	56	00007	00006	00006	00005	00005	00004
57	01662	01653	01644	01635	01626	01618	57	00004	00003	00003	00003	00002	00002
58	01609	01600	01591	01583	01574	01565	58	00002	00001	00001	00001	00001	00001
59	01557	01548	01540	01531	01523	01514	59	00000	00000	00000	00000	00000	00000

3	13. 3	14. 3	15. 4	16. 4	17. 4	18. 4	19. 5	20. 5	21. 5	22. 5	23. 6	23.34	5
4	13. 4	14. 5	15. 5	16. 5	17. 6	18. 6	19. 7	20. 7	21. 7	22. 8	23. 8	23.36	6
5	13. 6	14. 6	15. 7	16. 7	17. 8	18. 8	19. 9	20. 9	21.10	22.10	23.11	23.39	7
7	13. 8	14. 8	15. 9	16.10	17.10	18.11	19.12	20.12	21.13	22.14	23.14	23.43	8
9	13.10	14.11	15.11	16.12	17.13	18.14	19.15	20.16	21.16	22.17	23.18	23.47	9
11	13.12	14.13	15.14	16.15	17.16	18.17	19.18	20.19	21.20	22.21	23.23	23.51	10
14	13.15	14.16	15.17	16.18	17.20	18.21	19.22	20.23	21.25	22.26	23.27	23.56	11
16	13.18	14.19	15.21	16.22	17.24	18.25	19.26	20.28	21.30	22.31	23.33	24. 1	12
19	13.21	14.23	15.24	16.26	17.28	18.29	19.31	20.33	21.35	22.37	23.38	24. 7	13
22	13.24	14.26	15.28	16.30	17.32	18.34	19.36	20.38	21.40	22.43	23.45	24.14	14
26	13.28	14.30	15.33	16.35	17.37	17.39	19.42	20.44	21.47	22.49	23.52	24.21	15
29	13.32	14.35	15.37	16.40	17.42	18.45	19.48	20.51	21.53	22.56	23.59	24.28	16
33	13.36	14.39	15.42	16.45	17.48	18.51	19.54	20.57	22. 1	23. 4	24. 7	24.36	17
38	13.41	14.44	15.48	16.51	17.54	18.58	20. 1	21. 5	22. 8	23.12	24.15	24.45	18
42	13.46	14.49	15.53	16.57	18. 1	19. 5	20. 8	21.12	22.16	23.20	24.25	24.54	19
47	13.51	14.55	15.59	17. 3	18. 8	19.12	20.16	21.21	22.25	23.30	24.34	25. 4	20
52	13.57	15. 1	16. 6	17.10	18.15	19 20	20.25	21.29	22.34	23.39	24.45	25.15	21
57	14. 2	15. 7	16.13	17.18	18.23	19.28	20.33	21.39	22.44	23.50	24.55	25.26	22
3	14. 9	15.14	16.20	17.25	18.31	19.37	20.43	21.49	22.55	24. 1	25. 7	25.38	23
9	14.15	15.21	16.27	17.34	18.40	19.46	20.53	21.59	23. 6	24.13	25.19	25.51	24
16	14.22	15.29	16.36	17.42	18.49	19.56	21. 3	22.10	23.18	24.25	25.32	26. 4	25
22	14.30	15.37	16.44	17.52	18.59	20. 7	21.14	22.22	23.30	24.38	25.46	26.18	26
30	14.37	15.45	16.53	18. 1	19. 9	20.18	21.26	22.34	23.43	24.52	26. 1	26.33	27
37	14.46	15.54	17. 3	18.11	19.20	20.29	21.38	22.47	23.57	25. 6	26.16	26.48	28
45	14.54	16. 3	17.13	18.22	19.32	20.41	21.51	23. 1	24.11	25.22	26.32	27. 5	29
53	15. 3	16.13	17.23	18.34	19.44	20.54	22. 5	23.16	24.27	25.38	26.49	27.23	30
2	15.13	16.24	17.34	18.45	19.57	21. 8	22.19	23.31	24.43	25.55	27. 7	27.41	31
11	15.23	16.34	17.46	18.58	20.10	21.22	22.35	23.47	25. 0	26.13	27.26	28. 0	32
21	15.34	16.46	17.59	19.11	20.24	21.37	22.51	24. 4	25.18	26.32	27.46	28.21	33

DECLINATION IN DEGREES.

Lat.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23.28	Lat.
	D. M.	D. M.	D. M.	D. M.	D.M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M	D. M.	D. M.	D. M.	D. M.	
34°	1.12	2.25	3.37	4.50	6. 2	7.15	8.27	9.40	10.53	12. 5	13.18	14.31	15.45	16.58	18.11	19.25	20.39	21.53	23. 7	24.22	25.37	26.52	28. 7	28.42	34°
35	1.13	2.27	3.40	4.53	6. 6	7.20	8.33	9.47	11. 1	12.14	13.28	14.42	15.56	17.11	18.25	19.40	20.55	22.10	23.25	24.41	25.57	27.13	28.29	29. 5	35
36	1.14	2.28	3.43	4.57	6.11	7.25	8.40	9.54	11. 9	12.24	13.39	14.54	16. 9	17.24	18.39	19.55	21.11	22.27	23.44	25. 1	26.18	27.35	28.53	29.29	36
37	1.15	2.30	3.45	5. 1	6.16	7.31	8.47	10. 2	11.18	12.33	13.49	15. 5	16.22	17.38	18.55	20.11	21.28	22.46	24. 3	25.21	26.40	27.58	29.17	29.55	37
38	1.16	2.32	3.48	5. 5	6.21	7.37	8.54	10.10	11.27	12.44	14. 1	15.18	16.35	17.53	19.10	20.28	21.47	23. 5	24.24	25.43	27. 3	28.23	29.44	30.21	38
39	1.17	2.34	3.52	5. 9	6.26	7.44	9. 1	10.19	11.37	12.55	14.13	15.31	16.50	18. 8	19.27	20.46	22. 6	23.26	24.46	26. 7	27.28	28.49	30.11	30.49	39
40	1.18	2.37	3.55	5.13	6.32	7.51	9. 9	10.28	11.47	13. 6	14.25	15.45	17. 5	18.25	19.45	21. 5	22.26	23.47	25. 9	26.31	27.51	29.17	30.40	31.19	40
41	1.20	2.39	3.59	5.18	6.38	7.58	9.18	10.38	11.58	13.18	14.39	15.59	17.20	18.42	20. 3	21.25	22.48	24.10	25.33	26.57	28.24	29.46	31.11	31.51	41
42	1.21	2.42	4. 2	5.23	6.44	8. 5	9.26	10.48	12. 9	13.31	14.53	16.15	17.37	19. 0	20.23	21.46	23.10	24.34	25.59	27.24	28.50	30.16	31.43	32.24	42
43	1.22	2.44	4. 6	5.28	6.51	8.13	9.36	10.58	12.21	13.44	15. 7	16.31	17.55	19.19	20.44	22. 8	23.34	25.00	26.26	27.53	29.20	30.49	32.18	32.59	43
44	1.23	2.47	4.10	5.34	6.58	8.21	9.45	11. 9	12.34	13.58	15.23	16.48	18.13	19.39	21. 5	22.32	23.59	25.26	26.55	28.23	29.53	31.23	32.54	33.37	44
45	1.25	2.50	4.15	5.40	7. 5	8.30	9.55	11.21	12.47	14.13	15.39	17. 6	18.33	20.00	21.28	22.57	24.25	25.55	27.25	28.56	30.27	31.59	33.33	34.16	45
46	1.26	2.53	4.19	5.46	7.12	8.39	10. 6	11.33	13. 1	14.29	15.54	17.25	18.54	20.23	21.53	23.23	24.53	26.25	27.57	29.30	31. 3	32.38	34.14	34.59	46
47	1.28	2.56	4.24	5.52	7.21	8.49	10.18	11.46	13.16	14.45	16.15	17.45	19.16	20.47	22.18	23.50	25.23	26.57	28.31	30. 6	31.42	33.19	34.57	35.43	47
48	1.30	2.59	4.29	5.59	7.29	8.50	10.30	12. 0	13.31	15. 2	16.34	18. 6	19.39	21.12	22.45	24.20	25.55	27.30	29. 7	30.44	32.23	34. 3	35.44	36.31	48
49	1.31	3. 3	4.35	6. 6	7.38	9.10	10.42	12.15	13.48	15.21	16.54	18.29	20. 3	21.38	23.14	24.51	26.28	28. 6	29.45	31.25	33. 7	34.49	36.33	37.22	49
50	1.33	3. 7	4.40	6.14	7.48	9.22	10.56	12.30	14. 5	15.40	17.16	18.52	20.29	22. 7	23.45	25.24	27. 3	28.44	30.26	32. 9	33.53	35.39	37.26	38.17	50
51	1.35	3.11	4.46	6.22	7.58	9.34	11.10	12.47	14.24	16. 1	17.39	19.17	20.57	22.36	24.17	25.59	27.41	29.25	31. 9	32.55	34.43	36.32	38.23	39.15	51
52	1.37	3.15	4.53	6.30	8. 8	9.47	11.25	13. 4	14.43	16.23	18. 3	19.44	21.26	23. 8	24.52	26.36	28.21	30. 8	31.56	33.45	35.36	37.29	39.24	40.18	52
53	1.40	3.19	4.59	6.39	8.20	10. 0	11.41	13.22	15. 4	16.46	18.29	20.13	21.57	23.42	25.28	27.16	29. 4	30.54	32.45	34.38	36.33	38.30	40.29	41.26	53
54	1.42	3.24	5. 7	6.49	8.32	10.15	11.58	13.42	15.26	17.11	18.57	20.43	22.30	24.18	26. 7	27.58	29.50	31.49	33.38	35.35	37.34	39.36	41.40	42.39	54
55	1.45	3.29	5.14	6.59	8.44	10.30	12.16	14. 3	15.50	17.37	19.26	21.15	23. 5	24.57	26.49	28.43	30.39	32.36	34.35	36.36	38.40	40.47	42.56	43.58	55
56	1.47	3.35	5.22	7.10	8.58	10.46	12.35	14.25	16.15	18. 5	19.57	21.50	23.43	25.38	27.34	29.32	31.31	33.33	35.36	37.42	39.51	42. 4	44.20	45.24	56
57	1.50	3.40	5.31	7.22	9.13	11. 4	12.56	14.48	16.42	18.36	20.30	22.26	24.24	26.22	28.22	30.24	32.28	34.34	36.43	38.54	41. 9	43.27	45.50	46.59	57
58	1.53	3.47	5.40	7.34	9.28	11.23	13.18	15.14	17.10	19. 8	21.36	23. 6	25. 7	27.10	29.14	31.21	33.29	35.40	37.54	40.12	42.33	44.59	47.30	48.43	58
59	1.57	3.53	5.50	7.47	9.45	11.43	13.41	15.41	17.41	19.42	21.45	23.49	25.54	28. 1	30.10	32.21	34.35	36.52	39.12	41.37	44. 6	46.40	49.21	50.38	59
60	2. 0	4. 0	6. 0	8. 1	10. 2	12. 4	14. 6	16.10	18.14	20.19	22.26	24.34	26.44	28.56	31.10	33.27	35.47	38.10	40.38	43.10	45.47	48.31	51.24	52.47	60
61	2. 4	4. 8	6.11	8.16	10.21	12.27	14.34	16.41	18.49	20.59	23.11	25.24	27.39	29.56	32.16	34.39	37. 5	39.36	42.11	44.52	47.40	50.36	53.42	55.18	61
62	2. 8	4.16	6.24	8.33	10.49	12.52	15. 3	17.15	19.28	21.42	23.59	26.17	28.38	31. 1	33.27	35.57	38.31	41.10	43.54	46.46	49.46	52.56	56.20	58. 1	62
63	2.12	4.25	6.37	8.50	11. 4	13.19	15.34	17.51	20. 9	22.29	24.51	27.15	29.42	32.12	34.45	37.23	40. 5	42.54	45.49	48.53	52. 8	55.36	59.23	61.18	63
64	2.17	4.34	6.51	9. 9	11.28	13.48	16. 8	18.31	20.54	23.20	25.48	28.19	30.52	33.30	36.11	38.58	41.50	44.49	47.58	51.17	54.50	58.43	63. 2	65.17	64
65	2.22	4.44	7. 7	9.30	11.54	14.19	16.46	19.14	21.44	24.16	26.50	29.28	32.10	34.55	37.46	40.43	43.46	46.59	50.23	54. 2	57.59	62.25	67.36	69.26	65
66	2.28	4.55	7.24	9.53	12.22	14.54	17.26	20. 1	22.37	25.16	27.59	30.45	33.35	36.30	39.31	42.40	45.57	49.27	53.10	57.14	61.46	67. 4	73.52	78.15	66

A TABLE showing the Time of the Sun, Moon, and stars setting; when the Latitude and Declination are of the same Name; and the Time of its rising, when the Latitude and Declination are of different Names.

TABLE XX.

	DEGREES OF DECLINATION.																									
Lat.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23.28	Lat.
	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	
1°	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.02	6.02	6.02	6.02	1°
2	6.00	6.00	6.00	6.00	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.02	6.02	0.02	6.02	6.02	6.02	6.02	6.03	6.03	6.03	6.03	6.03	6.03	6.03	2
3	6.00	6.00	6.00	6.01	6.01	6.01	6.01	6.01	6.02	6.02	6.02	6.02	6.03	6.03	6.03	6.03	6.03	6.04	6.04	6.04	6.04	6.05	6.05	6.05	6.05	3
4	6.00	6.00	6.01	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.03	6.04	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.06	6.06	6.07	6.07	4
5	6.00	6.00	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.04	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.07	6.08	6.08	6.09	6.09	5
6	6.00	6.00	6.01	6.01	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.06	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09	6.10	6.10	6.10	6
7	6.00	6.00	6.01	6.01	6.02	6.02	6.03	6.03	6.04	6.04	6.05	6.05	6.06	6.06	6.07	6.08	6.08	6.09	6.09	6.10	6.10	6.11	6.11	6.12	6.12	7
8	6.00	6.01	6.01	6.02	6.02	6.03	6.03	6.04	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.09	6.09	6.10	6.10	6.11	6.12	6.12	6.13	6.14	6.14	8
9	6.00	6.01	6.01	6.02	6.03	6.03	6.04	6.04	6.05	6.06	6.06	6.07	6.08	6.08	6.09	6.10	6.10	6.11	6.12	6.13	6.13	6.14	6.15	6.15	6.16	9
10	6.00	6.01	6.01	6.02	6.03	6.04	6.04	6.05	6.06	6.06	6.07	6.08	6.09	6.09	6.10	6.11	6.12	6.12	6.13	6.14	6.15	6.16	6.16	6.17	6.18	10
11	6.00	6.01	6.02	6.02	6.03	6.04	6.05	6.05	6.06	6.07	6.08	6.09	6.09	6.10	6.11	6.12	6.13	6.14	6.14	6.15	6.16	6.17	6.18	6.19	6.19	11
12	6.00	6.01	6.02	6.03	6.03	6.04	6.05	6.06	6.07	6.08	6.09	6.09	6.10	6.11	6.12	6.13	6.14	6.15	6.16	6.17	6.18	6.19	6.20	6.21	6.21	12
13	6.00	6.01	6.02	6.93	6.04	6.05	6.06	6.06	6.07	6.08	6.09	6.10	6.11	6.12	6.13	6.14	6.15	6.16	6.17	6.18	6.19	6.20	6.21	6.22	6.23	13
14	6.00	6.01	6.02	6.03	6.04	6.05	6.06	6.07	6.08	6.09	6.10	6.11	6.12	6.13	6.14	6.15	6.16	6.17	6.19	6.20	6.21	6.22	6.23	6.24	6.25	14
15	6.00	6.01	6.02	6.03	6.04	6.05	6.06	6.08	6.09	6.10	6.11	6.12	6.13	6.14	6.15	6.16	6.18	6.19	6.20	6.21	6.22	6.24	6.25	6.26	6.27	15
16	6.00	6.01	6.02	6.03	6.05	6.06	6.07	6.08	6.09	6.10	6.12	6.13	6.14	6.15	6.16	6.18	6.19	6.20	6.21	6.23	6.24	6.25	6.27	6.28	6.29	16
17	6.00	6.01	6.02	6.04	6.05	6.06	6.07	6.09	6.10	6.11	6.12	6.14	6.15	6.16	6.17	6.19	6.20	6.21	6.23	6.24	6.26	6.27	6.28	6.30	6.31	17
18	6.00	6.01	6.03	6.04	6.05	6.07	6.08	6.09	6.10	6.12	6.13	6.14	6.16	6.17	6.19	6.20	6.21	6.23	6.24	6.26	6.27	6.29	6.30	6.32	6.32	18
19	6.00	6.01	6.03	6.04	6.06	6.07	6.08	6.10	6.11	6.13	6.14	6.15	6.17	6.18	6.20	6.21	6.23	6.24	6.26	6.27	6.29	6.30	6.32	6.34	6.34	19
20	6.00	6.01	6.03	6.04	6.06	6.07	6.09	6.10	6.12	6.13	6.15	6.16	6.18	6.19	6.21	6.22	6.24	6.26	6.27	6.29	6.30	6.32	6.34	6.36	6.36	20
21	6.00	6.02	6.03	6.05	6.06	6.08	6.09	6.11	6.12	6.14	6.16	6.17	6.19	6.20	6.22	6.24	6.25	6.27	6.29	6.30	6.32	6.34	6.36	6.38	6.38	21
22	6.00	6.02	6.03	6.05	6.06	6.08	6.10	6.11	6.13	6.15	6.16	6.18	6.20	6.21	6.23	6.25	6.27	6.28	6.30	6.32	6.34	6.36	6.38	6.39	6.40	22
23	6.00	6.02	6.03	6.05	6.07	6.09	6.10	6.12	6.14	6.15	6.17	6.19	6.21	6.22	6.24	6.26	6.28	6.30	6.32	6.34	6.36	6.38	6.39	6.42	6.42	23
24	6.00	6.02	6.04	6.05	6.07	6.09	6.11	6.13	6.14	6.16	6.18	6.20	6.22	6.24	6.25	6.27	6.29	6.31	6.33	6.35	6.37	6.39	6.41	6.44	6.45	24
25	6.00	6.02	6.04	6.06	6.07	6.09	6.11	6.13	6.15	6.17	6.19	6.21	6.23	6.25	6.27	6.29	6.31	6.33	6.35	6.37	6.39	6.41	6.43	6.46	6.47	25
26	6.00	6.02	6.04	6.06	6.08	6.10	6.12	6.14	6.16	6.18	6.20	6.22	6.24	6.26	6.28	6.30	6.32	6.34	6.36	6.39	6.41	6.43	6.45	6.48	6.49	26
27	6.00	6.02	6.04	6.06	6.08	6.10	6.12	6.14	6.16	6.19	6.21	6.23	6.25	0.27	6.29	6.31	6.34	6.36	6.38	6.40	6.43	6.45	6.48	6.50	6.51	27
28	6.00	6.02	6.04	6.06	6.09	6.11	6.13	6.15	6.17	6.19	6.22	6.24	6.26	6.28	6.30	6.33	6.35	6.37	6.40	6.42	6.45	6.47	6.50	6.52	6.53	28
29	6.00	6.02	6.04	6.07	6.09	6.11	6.13	6.16	6.18	6.20	6.22	6.25	6.27	6.29	6.32	6.34	6.37	6.39	6.42	6.44	6.47	6.49	6.52	6.54	6.56	29
30	6.00	6.02	6.05	6.07	6.09	6.12	6.14	6.16	6.19	6.21	6.23	6.26	6.28	6.31	6.33	6.36	6.38	6.41	6.43	6.46	6.49	6.51	6.54	6.57	6.58	30

A TABLE showing the Time of the Sun, Moon, and Star's setting, when the Latitude and Declination are of the same Name and the Time of its rising, when the Latitude and Declination are of different Names.

	DEGREES OF DECLINATION.																								
Lat.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23 28	Lat.
	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	
31°	6.00	6.02	6.05	6.07	6.10	6.12	6.14	6.17	6.19	6.22	6.24	6.27	6.29	6.32	6.34	6.37	6.40	6.42	6.45	6.48	6.51	6.53	6.56	6.59	7.00	31°
32	6.00	6.02	6.05	6.08	6.10	6.13	6.15	6.18	6.20	6.23	6.25	6.28	6.31	6.33	6.36	6.39	6.41	6.44	6.47	6.50	6.53	6.56	6.58	7.02	7.03	32
33	6.00	6.03	6.05	6.08	6.10	6.13	6.16	6.18	6.21	6.24	6.26	6.29	6.32	6.34	6.37	6.40	6.43	6.46	6.49	6.52	6.55	6.58	7.01	7.04	7.05	33
34	6.00	6.03	6.05	6.08	6.11	6.14	6.16	6.19	6.22	6.25	6.27	6.30	6.33	6.36	6.39	6.42	6.45	6.48	6.51	6.54	6.57	7.00	7.03	7.07	7.08	34
35	6.00	6.03	6.06	6.08	6.11	6.14	6.17	6.20	6.23	6.25	6.28	6.31	6.34	6.37	6.40	6.43	6.46	6.49	6.53	6.56	6.59	7.02	7.06	7.09	7.11	35
36	6.00	6.03	6.06	6.09	6.12	6.15	6.18	6.20	6.23	6.26	6.29	6.32	6.36	6.39	6.42	6.45	6.48	6.51	6.55	6.58	7.01	7.05	7.08	7.12	7.14	36
37	6.00	6.03	6.05	6.09	6.12	6.15	6.18	6.21	6.24	6.27	6.31	6.34	6.37	6.40	6.43	6.47	6.50	6.53	6.57	7.00	7.04	7.07	7.11	7.15	7.16	37
38	6.00	6.03	6.06	6.09	6.13	6.16	6.19	6.22	6.25	6.28	0.32	6.35	6.38	6.42	6.45	6.48	6.52	6.55	6.59	7.02	7.06	7.10	7.14	7.17	7.19	58
39	6.00	6.03	6.06	6.10	6.13	6.16	6.20	6.23	6.26	6.29	6.33	6.36	6.40	6.43	6.47	6.50	6.54	6.57	7.01	7.05	7.09	7.12	7.16	7.20	7.22	39
40	6.00	6.03	6.07	6.10	6.13	6.17	6.20	6.24	6.27	6.31	6.34	6.38	6.41	6.45	6.48	6.52	6.56	6.59	7.03	7.07	7.11	7.15	7.19	7.23	7.25	40
41	6.00	6.03	6.97	6.10	6.14	6.17	6.21	6.25	6.28	6.32	6.35	6.39	6.43	6.46	6.50	6.54	6.58	7.02	7.06	7.10	7.14	7.18	7.22	7.27	7.29	41
42	6.00	6.04	6.07	6.11	6.14	6.18	6.22	6.25	6.29	6.33	6.37	6.40	6.44	6.48	6.52	6.56	7.00	7.04	7.08	7.12	7.17	7.21	7.25	7.30	7.32	42
43	6.00	6.04	6.07	6.11	6.15	6.19	6.22	6.26	6.30	6.34	6.38	6.42	6.46	6.50	6.54	6.58	7.02	7.06	7.11	7.15	7.19	7.24	7.29	7.33	7.36	43
44	6.00	6.04	6.08	6.12	6.15	6.19	6.23	6.27	6.31	6.35	6.39	6.43	6.47	6.52	6.56	7.00	7.04	7.09	7.13	7.18	7.22	7.27	7.32	7.37	7.39	44
45	6.00	6.04	6.08	6.12	6.16	6.20	6.24	6.28	6.32	6.36	6.41	6.45	6.49	6.53	6.58	7.02	7.07	7.11	7.16	4.21	7.25	7.30	7.35	7.40	7.43	45
46	6.00	6.04	6.08	6.12	6.17	6.21	6.25	6.29	6.33	6.38	6.42	6.46	6.51	6.55	7.00	7.04	7.09	7.14	7.19	7.24	7.29	7.34	7.39	7.44	7.47	46
47	6.00	6.04	6.09	6.13	6.17	6.22	6.26	6.30	6.35	6.39	6.44	6.48	6.53	6.57	7.02	7.07	7.12	7.17	7.22	7.27	7.32	7.37	7.43	7.48	7.51	47
48	6.00	6.04	6.09	6.13	6.18	6.22	6.27	6.31	6.36	6.41	6.45	6.50	6.55	6.59	7.04	7.09	7.14	7.19	7.25	7.30	7.35	7.41	7.47	7.53	7.55	48
49	6.00	6.05	6.09	6.14	6.18	6.23	6.28	6.32	6.37	6.42	6.47	6.52	6.57	7.02	7.07	7.12	7.17	7.22	7.28	7.33	7.39	7.45	7.51	7.57	8.00	49
50	6.00	6.05	6.10	6.14	6.19	6.24	6.29	6.34	6.39	6.44	6.49	6.54	6.59	7.04	7.09	7.14	7.20	7.25	7.31	7.37	7.43	7.49	7.55	8.02	8.05	50
51	6.00	6.05	6.10	6.15	6.20	6.25	6.30	6.35	6.40	6.45	6.50	6.56	7.01	7.06	7.12	7.17	7.23	7.29	7.35	7.41	7.47	7.53	8.00	8.06	8.10	51
52	6.00	6.05	6.10	6.15	6.21	6.26	6.31	6.36	6.41	6.47	6.52	6.58	7.03	7.09	7.14	7.20	7.26	7.32	7.38	7.45	7.51	7.58	8.05	8.12	8.15	52
53	6.00	6.05	6.11	6.16	6.21	6.27	6.32	6.38	6.43	6.49	6.54	7.00	7.06	7.11	7.17	7.23	7.29	7.36	7.42	7.49	7.56	8.02	8.10	8.17	8.21	53
54	6.00	6.06	6.11	6.17	6.22	6.28	6.33	6.39	6.45	6.50	6.56	7.02	7.08	7.14	7.20	7.27	7.33	7.40	7.46	7.53	8.00	8.08	8.15	8.23	8.27	54
55	6.00	6.06	6.11	6.17	6.23	6.29	6.35	6.40	6.46	6.52	6.58	7.04	7.11	7.17	7.23	7.30	7.37	7.44	7.51	7.58	8.05	8.13	8.21	8.29	8.33	55
56	6.00	6.06	6.12	6.18	6.24	6.30	6.36	6.42	6.48	6.54	7.01	7.07	7.13	7.20	7.27	7.34	7.41	7.48	7.55	8.03	8.11	8.19	8.27	8.36	8.40	56
57	6.00	6.06	6.12	6.19	6.25	6.31	6.37	6.44	6.50	6.56	7.03	7.10	7.16	7.23	7.30	7.37	7.45	7.52	8.00	8.08	8.16	8.25	8.34	8.43	8.48	57
58	6.00	6.06	6.13	6.19	6.26	6.32	6.39	6.45	6.52	6.59	7.06	7.12	7.20	7.27	7.34	7.42	7.49	7.57	8.05	8.14	8.22	8.32	8.41	8.51	8.56	58
59	6.00	6.07	6.13	6.20	6.27	6.33	6.40	6.47	6.54	7.01	7.08	7.15	7.23	7.30	7.38	7.46	7.54	8.02	8.11	8.20	8.29	8.39	8.49	9.00	9.05	59
60	6.00	6.07	6.14	6.21	6.28	6.35	6.42	6.49	6.56	7.04	7.11	7.19	7.26	7.34	7.42	7.51	7.59	8.08	8.17	8.26	8.36	8.47	8.58	9.09	9.15	60

TABLE XXI.

For Finding the Distance of Terrestrial Objects at Sea.

Ht. Ft.	Dist. M. D.	Ht. Ft.	Dist. M. D.	Ht. Ft.	Dist. M. D.	Ht. Ft.	Dist. M. D.
1	1. 32	44	8. 78	320	23. 67	1000	41. 8
2	1. 87	45	8. 87	330	24. 03	1100	43. 9
3	2. 29	46	8. 97	340	24. 39	1200	45. 8
4	2. 65	47	9. 07	350	24. 75	1300	47. 7
5	2. 96	48	9. 17	360	25. 10	1400	49. 5
6	3. 24	49	9. 26	370	25. 45	1500	51. 2
7	3. 50	50	9. 35	380	25. 79	1600	52. 9
8	3. 74	55	9. 81	390	26. 13	1700	54. 5
9	3. 97	60	10. 25	400	26. 46	1800	56. 1
10	4. 18	65	10. 67	410	26. 79	1900	57. 7
11	4. 39	70	11. 07	420	27. 11	2000	59. 2
12	4. 58	75	11. 46	430	27. 43	2100	60. 6
13	4. 77	80	11. 83	440	27. 75	2200	62. 1
14	4. 95	85	12. 20	450	28. 06	2300	63. 4
15	5. 12	90	12. 55	460	28. 37	2400	64. 8
16	5. 29	95	12. 89	470	28. 68	2500	66. 1
17	5. 45	100	13. 23	480	28. 98	2600	67. 5
18	5. 61	105	13. 56	490	29. 29	2700	68. 7
19	5. 77	110	13. 88	500	29. 58	2800	70. 0
20	5. 92	115	14. 19	520	30. 17	2900	71. 2
21	6. 06	120	14. 49	540	30. 74	3000	72. 5
22	6. 21	125	14. 79	560	31. 31	3100	73. 7
23	6. 34	130	15. 08	580	31. 86	3200	74. 8
24	6. 48	135	15. 37	600	32. 41	3300	76. 0
25	6. 61	140	15. 65	620	32. 94	3400	77. 1
26	6. 75	145	15. 93	640	33. 47	3500	78. 3
27	6. 87	150	16. 20	660	33. 99	3600	79. 4
28	7. 00	160	16. 73	680	34. 50	3700	80. 5
29	7. 12	170	17. 25	700	35. 00	3800	81. 6
30	7. 25	180	17. 75	720	35. 50	3900	82. 6
31	7. 37	190	18. 24	740	35. 99	4000	83. 7
32	7. 48	200	18. 71	760	36. 47	4100	84. 7
33	7. 60	210	19. 17	780	36. 95	4200	85. 7
34	7. 71	220	19. 62	800	37. 42	4300	86. 8
35	7. 83	230	20. 06	820	37. 88	4400	87. 8
36	7. 94	240	20. 50	840	38. 34	4500	88. 7
37	8. 05	250	20. 92	860	38. 80	4600	89. 7
38	8. 16	260	21. 33	880	39. 25	4700	90. 7
39	8. 26	270	21. 74	900	39. 69	4800	91. 7
40	8. 37	280	22. 14	920	40. 13	4900	92. 6
41	8. 47	290	22. 53	940	40. 56	5000	93. 5
42	8. 57	300	22. 91	960	40. 99		
43	8. 68	310	23. 29	980	41. 42	1 M.	96. 1

TABLE XXII.

Proportion of Powder for Sea-Guns.

Pdrs.	Proof.	Service.	Saluting.	Scaling.
	lb. oz.	lb. oz.	lb. oz.	lb. oz.
42	25. 0	14. 0	10. 0	3. 0
32	21. 0	10.11	8. 0	2.12
24	18. 0	8. 0	6. 0	2. 0
18	15. 0	6. 0	4. 8	1. 8
12	12. 0	4. 0	3. 0	1. 0
9	9. 0	3. 0	2. 4	0.12
6	6. 0	2. 0	2. 0	0. 8
4	4. 0	1. 5	1. 5	0. 6
3	3. 0	1. 0	1. 0	0. 4
½	0. 8	0. 3	0. 3	0. 1
Caronades.				
42	9. 0	4. 8	4. 8	1. 8
32	8. 0	4. 0	4. 0	1. 4
24	6 0	3. 0	3. 0	1. 0
18	4. 0	2. 0	2. 0	1. 0
12	3. 0	1. 8	1. 8	0.12
Wall Pieces.				
	2.8	0.10		
Musquets.				
	0.12	0. 6		
Pistols.				
	0.6	0.3		

N. B. These proportions are with powder in good condition; if it is damp, or damaged, a greater quantity will be necessary.

A TABLE of the Number and sorts of Shot contained in the Grapes for the nature of Guns undermentioned.

Pdrs.	Shot.	No. in each.	No. in each box.
42	4lb.	9	4
32	3	9	4
24	2	9	6
18	1½	9	8
12	1	9	10
	Oz.		
9	13	9	12
6	8	9	20
4	6	9	20

Half elapsed Time.

	0 Hour.							1 Hour.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0		13833	83730	66121	53627	43936	0	0.58700	58582	58465	58348	58231	58115
1	2.36018	29324	23525	18409	13834	09695	1	57999	57883	57768	57653	57538	57424
2	05916	02440	99221	96225	93422	90790	2	57310	57196	57083	56970	56857	56745
3	1.88307	85959	83732	81613	79593	77663	3	56633	56521	56409	56298	56187	56076
4	75814	74042	72339	70700	69121	67597	4	55966	55856	55746	55637	55528	55419
5	66125	64701	63322	61986	60690	59431	5	55311	55203	55095	54987	54880	54773
6	58208	57018	55861	54733	53634	52561	6	54666	54559	54453	54347	54241	54136
7	51515	50494	49496	48520	47566	46632	7	54031	53926	53822	53718	53614	53510
8	45718	44823	43946	43086	42243	41417	8	53406	53303	53200	53097	52995	52893
9	40605	39809	39027	38258	37503	36762	9	52791	52690	52589	52488	52387	52286
10	1.36032	35315	34609	33915	33231	32558	10	0.52186	52086	51986	51886	51787	51688
11	31896	31243	30600	29967	29342	28727	11	51589	51490	51392	51294	51196	51099
12	28120	27522	26931	26349	25774	25207	12	51002	50905	50808	50711	50615	50519
13	24647	24095	23549	23010	22477	21952	13	50423	50327	50232	50137	50042	49947
14	21432	20919	20412	19910	19415	18925	14	49852	49758	49664	49570	49476	49383
15	18440	17961	17487	17018	16554	16096	15	49290	49197	49104	49012	48920	48828
16	15642	15192	14748	14307	13872	13440	16	48736	48644	48553	48462	48371	48280
17	13013	12590	12171	11757	11346	10939	17	48189	48099	48009	47919	47829	47739
18	10536	10136	09740	09348	08960	08575	18	47650	47561	47472	47383	47295	47207
19	08193	07814	07439	07067	06698	06333	19	47119	47031	46943	46856	46769	46682
20	1.05970	05610	05254	04901	04550	04202	20	0.46595	46508	46421	46335	46249	46163
21	03857	03515	03175	02838	02504	02172	21	46077	45992	45907	45822	45737	45652
22	01843	01516	01192	00870	00550	00233	22	45567	45583	45399	45315	45231	45147
23	0.99918	99606	99296	98988	98682	98378	23	45064	44981	44898	44815	44732	44649
24	98077	97777	97480	97184	96891	96600	24	44567	44485	44403	44321	44239	44158
25	96310	96023	95738	95454	95172	94892	25	44077	43996	43915	43834	43753	43673
26	94614	94338	94063	93790	93519	93250	26	43593	43513	43433	43353	43273	43193
27	92982	92716	92452	92189	91928	91669	27	43114	43035	42956	42877	42799	42721
28	91411	94154	90899	90646	90394	90143	28	42643	42565	42487	42409	42331	42253
29	89894	89647	89401	89156	88913	88671	29	42176	42099	42022	41945	41868	41792
30	0.88430	88191	87953	87717	87481	87247	30	0.41716	41640	41564	41488	41412	41336
31	87015	86783	86553	86324	86096	85870	31	41261	41186	41111	41036	40961	40886
32	85644	85420	85197	84976	84755	84535	32	40812	40738	40664	40590	40516	40442
33	84317	84100	83884	83669	83455	83242	33	40368	40295	40222	40149	40076	40003
34	83030	82819	82609	82401	82193	81986	34	39930	39857	39785	39713	39641	39569
35	81780	81576	81372	81169	80967	80767	35	39497	39425	39353	39282	39211	39140
36	80567	80368	80170	79973	79777	79581	36	39069	38998	38927	38856	38786	38716
37	79387	79193	79001	78809	78618	78428	37	38646	38576	38506	38436	38366	38296
38	78239	78051	77863	77677	77491	77306	38	38227	38158	38089	38020	37951	37882
39	77122	76938	76756	76574	76393	76212	39	37813	37745	37677	37609	37541	37473
40	0.76033	75854	75676	75499	75323	75147	40	0.37405	37337	37269	37202	37135	37068
41	74972	74797	74624	74451	74279	74107	41	37001	36934	36867	36800	36734	36668
42	73937	73767	73597	73429	73261	73093	42	36602	36536	36470	36404	36338	36272
43	72926	72760	72595	72430	72266	72103	43	36206	36141	36076	36011	35946	35881
44	71940	71778	71616	71455	71295	71135	44	35816	35751	35686	35622	35558	35494
45	70976	70818	70660	70503	70346	70190	45	35430	35366	35302	35238	35174	35110
46	70034	69879	69725	69571	69418	69265	46	35047	34984	34921	34858	34795	34732
47	69113	68962	68811	68660	68510	68361	47	34669	34606	34544	34483	34420	34358
48	68212	68064	67916	67769	67622	67476	48	34296	34234	34172	34110	34048	33986
49	67330	67185	67040	66896	66752	66609	49	33925	33864	33803	33742	33681	33620
50	0.66466	66324	66182	66041	65900	65760	50	0.33559	33498	33438	33378	33318	33258
51	65620	65481	65342	65204	65066	64928	51	33197	33137	33077	33017	32958	32899
52	64791	64655	64519	64383	64248	64113	52	32839	32780	32720	32661	32602	32543
53	63978	63844	63711	63578	63445	63313	53	32485	32426	32367	32309	32250	32192
54	63181	63050	62919	62789	62659	62529	54	32134	32076	32018	31960	31902	31844
55	62400	62271	62142	62014	61886	61759	55	31787	31729	31672	31614	41557	31500
56	61632	61506	61380	61254	61129	61004	56	31443	31386	31329	31272	31216	31159
57	60879	60755	60631	60508	60385	60262	57	31103	31046	30990	30934	30878	30822
58	60140	60018	59896	59775	59654	59534	58	30766	30710	30655	[illegible]	30544	30488
59	59414	59294	59175	59056	58937	58818	59	30433	30378	30323	30268	30213	30158

Half Elapsed Time.

2 Hours.								3 Hours.						
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0	0.30103	30048	29994	29939	29885	29831	0	0.15051	15020	14988	14957	14926	14894
1	29776	29722	29668	29614	29560	29507	1	14863	14832	14800	14769	14738	14707
2	29453	29399	29346	29293	29239	29186	2	14676	14645	14614	14583	14552	14521
3	29133	29080	29027	28974	28921	28869	3	14490	14460	14429	14398	14368	14337
4	28816	28764	28711	28659	28607	28554	4	14307	14276	14246	14215	14185	14155
5	28502	28450	28398	28346	28295	28243	5	14124	14094	14064	14034	14004	13974
6	28191	28140	28089	28037	27986	27935	6	13944	13914	13884	13854	13824	13794
7	27884	27833	27782	27731	27680	27630	7	13765	13735	13705	13676	13646	13617
8	27579	27529	27478	27428	27378	27327	8	13587	13558	13528	13499	13470	13441
9	27277	27227	27177	27127	27077	27028	9	13411	13382	13353	13324	13295	13266
10	0.26978	26929	26879	26830	26781	26731	10	0.13237	13208	13179	13150	13121	13093
11	26682	26633	26584	26535	26486	26438	11	13064	13035	13007	12978	12950	12921
12	26389	26340	26292	26244	26195	26147	12	12893	12864	12835	12807	12779	12751
13	26099	26051	26003	25955	25907	25859	13	12723	12695	12666	12638	12610	12582
14	25811	25763	25716	25668	25621	25573	14	12554	12526	12499	12471	12443	12415
15	25526	25479	25432	25385	25338	25291	15	12387	12360	12332	12305	12277	12249
16	25244	25197	25150	25104	25057	25011	16	12222	12195	12167	12140	12113	12085
17	24964	24918	24872	24825	24779	24733	17	12058	12031	12004	11977	11949	11922
18	24687	24641	24595	24550	24504	24458	18	11895	11868	11842	11815	11788	11761
19	24413	24367	24322	24276	24231	24186	19	11734	11708	11681	11654	11628	11601
20	0.24141	24096	24051	24006	23961	23916	20	0.11575	11548	11522	11495	11469	11443
21	23871	23827	23782	23738	23693	23649	21	11416	11390	11364	11333	11312	11285
22	23605	23560	23516	23472	23428	23384	22	11259	11233	11207	11181	11155	11130
23	23340	23296	23252	23209	23165	23122	23	11104	11078	11052	11027	11001	10975
24	23078	23035	22991	22948	22905	22862	24	10950	10924	10899	10873	10848	10822
25	22819	22775	22732	22690	22647	22604	25	10797	10772	10746	10721	10696	10671
26	22561	22519	22476	22433	22391	22349	26	10646	10620	10595	10570	10545	10520
27	22306	22264	22222	22180	22138	22096	27	10495	10471	10446	10421	10396	10371
28	22054	22012	21970	21928	21887	21845	28	10347	10322	10297	10272	10248	10224
29	21803	21762	21720	21679	21638	21596	29	10199	10175	10151	10126	10102	10078
30	0.21555	21514	21473	21432	21391	21350	30	0.10053	10029	10005	09981	09957	09933
31	21309	21269	21228	21187	21147	21106	31	09909	09885	09861	09837	09813	09789
32	21066	21025	20985	20945	20905	20864	32	09765	09741	09718	09694	09670	09647
33	20824	20784	20744	20704	20665	20625	33	09623	09599	09576	09552	09529	09506
34	20585	20545	20506	20466	20427	20387	34	09482	09459	09435	09412	09389	09366
35	20348	20309	20269	20230	20191	20152	35	09343	09319	09296	09273	09250	09227
36	20113	20074	20035	19996	19957	19919	36	09204	09181	09158	09136	09113	09090
37	19880	19841	19803	19764	19726	19687	37	09067	09044	09022	08999	08976	08954
38	19649	19611	19572	19534	19496	19458	38	08931	08909	08886	08864	08842	08819
39	19420	19382	19344	19306	19269	19231	39	08797	08774	08752	08730	08708	08686
40	0.19193	19156	19118	19081	19043	19006	40	0.08664	08641	08619	08597	08575	08553
41	18968	18931	18894	18857	18820	18783	41	08531	08510	08488	08466	08444	08422
42	18746	18709	18672	18635	18598	18561	42	08401	08379	08357	08336	08314	08293
43	18525	18488	18451	18415	18378	18342	43	08271	08250	08228	08207	08185	08164
44	18306	18269	18233	18197	18161	18124	44	08143	08121	08100	08079	08058	08036
45	18089	18053	18017	17981	17945	17909	45	08015	07994	07973	07952	07931	07910
46	17874	17838	17802	17767	17731	17696	46	07889	07868	07848	07827	07806	07785
47	17660	17625	17590	17554	17519	17484	47	07765	07744	07723	07703	07682	07661
48	17449	17414	17379	17344	17309	17274	48	07641	07620	07600	07579	07559	07539
49	17239	17205	17170	17135	17101	17066	49	07518	07498	07478	07458	07437	07417
50	0.17032	16997	16963	16928	16894	16860	50	0.07397	07377	07357	07337	07317	07297
51	16826	16792	16758	16724	16690	16656	51	07277	07257	07237	07217	07197	07178
52	16622	16588	16554	16520	16487	16453	52	07158	07138	07119	07099	07079	07060
53	16419	16386	16352	16319	16285	16252	53	07040	07021	07001	06982	06962	06943
54	16219	16186	16152	16119	16086	16053	54	06923	06904	06885	06865	06846	06827
55	16020	15987	15954	15920	15888	15856	55	06808	06789	06770	06751	06731	06712
56	15823	15790	15758	15725	15692	15660	56	06693	06674	06656	06637	06618	06599
57	15628	15595	15563	15530	15498	15466	57	06580	06561	06543	06524	06505	06487
58	15434	15402	15370	15338	15306	15274	58	06468	06449	06431	06412	06394	06375
59	15242	15210	15178	15146	15115	15083	59	06357	06338	06320	[illegible]	[illegible]	[illegible]

TABLE XXIII. For finding the Latitude by two Altitudes of the Sun.

Half Elapsed Time.

	4 Hours.							5 Hours.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0	0.06247	06229	06211	06192	06174	06156	0	0.01506	01497	01489	01480	01472	01464
1	06138	06120	06102	06084	06066	06048	1	01455	01447	01439	01430	01422	01414
2	06030	06012	05995	05977	05959	05941	2	01406	01398	01390	01381	91373	01365
3	05924	05906	05888	05871	05853	05836	3	01357	01349	01341	01333	01325	01317
4	05818	05801	05783	05766	05748	05731	4	01310	01302	01294	01286	01278	01270
5	05714	05696	05679	05662	05645	05627	5	01263	01255	01247	01240	01232	01224
6	05610	05593	05576	05559	05542	05525	6	01217	01209	01202	01194	01187	01179
7	05508	05491	05474	05457	05440	05423	7	01172	01164	01157	01150	01142	01135
8	05406	05389	05373	05356	05340	05323	8	01128	01120	01113	01106	01099	01091
9	05306	05290	05273	05257	05240	05224	9	01084	01077	01070	01063	01056	01049
10	0.05207	05191	05174	05158	05142	05125	10	0.01042	01035	01028	01021	01014	01007
11	05109	05093	05076	05060	05044	05028	11	01000	00993	00987	00980	00973	00966
12	05012	04996	04980	04964	04948	04932	12	00960	00953	00946	00940	00933	00926
13	04916	04900	04884	04868	04852	04837	13	00920	00913	00907	00900	00894	00887
14	04821	04805	04789	04774	04758	04743	14	00881	00874	00868	00862	00855	00849
15	04727	04711	04696	04680	04665	04649	15	00843	00836	00830	00824	00818	00811
16	04634	04619	04603	04588	04573	04557	16	00805	00799	00793	00787	00781	00775
17	04542	04527	04512	04496	04481	04466	17	00769	00763	00757	00751	00745	00739
18	04451	04436	04421	04406	04391	04376	18	00733	00728	00721	00716	00710	00704
19	04361	04346	04332	04317	04302	04287	19	00699	00693	00687	00682	00676	00670
20	0.04272	04258	04243	04228	04214	04199	20	0.00665	00659	00654	00648	00643	00637
21	04185	04170	04155	04141	04127	04112	21	00632	00626	00621	00616	00610	00605
22	04098	04083	04069	04055	04040	04026	22	00600	00594	00589	00584	00579	00574
23	04012	03998	03983	03969	03955	03941	23	00568	00563	00558	00553	00548	00543
24	03927	03913	03899	03885	03871	03857	24	00538	00533	00528	00523	00518	00513
25	03843	03829	03815	03802	03788	03774	25	00508	00504	00499	00494	00489	00484
26	03760	03746	03733	03719	03706	03692	26	00480	00475	00470	00466	00461	00456
27	03678	03665	03651	03638	03624	03611	27	00452	00447	00443	00438	00434	00429
28	03597	03584	03571	03557	03544	03531	28	00425	00420	00416	00412	00407	00403
29	03517	03504	03491	03478	03465	03452	29	00399	00394	00390	00386	00382	00377
30	0.03438	03425	03412	03399	03386	03373	30	0.00373	00369	00365	00361	00357	00353
31	03360	03348	03335	03322	03309	03296	31	00349	00345	00341	00337	00333	00329
32	03283	03271	03258	03245	03233	03220	32	00325	00321	00317	00313	00310	00306
33	03207	03195	03182	03170	03157	03145	33	00302	00298	00295	00291	00287	00284
34	03132	03120	03107	03095	03083	03070	34	00280	00276	00273	00269	00266	00262
35	03058	03046	03034	03021	03009	02997	35	00259	00255	00252	00249	00245	00242
36	02985	02973	02961	02949	02937	02925	36	00239	00235	00232	00229	00225	00222
37	02913	02901	02889	02877	02865	02853	37	00219	00216	00213	00210	00207	00203
38	02841	02829	02818	02806	02794	02783	38	00200	00197	00194	00191	00188	00185
39	02771	02759	02748	02736	02724	02713	39	00183	00180	00177	00174	00171	00168
40	0.02701	02690	02678	02667	02656	02644	40	0.00166	00163	00160	00157	00155	00152
41	02633	02622	02610	02599	02588	02577	41	00149	00147	00144	00142	00139	00137
42	02565	02554	02543	02532	02521	02510	42	00134	00132	00129	00127	00124	00122
43	02499	02488	02477	02466	02455	02444	43	00120	00117	00115	00113	00110	00108
44	02433	02422	02411	02400	02390	02379	44	00106	00104	00102	00099	00097	00095
45	02368	02357	02347	02336	02326	02315	45	00093	00091	00089	00087	00085	00083
46	02304	02294	02283	02273	02262	02252	46	00081	00079	00077	00075	00074	00072
47	02241	02231	02221	02210	02200	02190	47	00070	00068	00066	00065	00063	00061
48	02179	02169	02159	02149	02139	02128	48	00060	00058	00056	00055	00053	00052
49	02118	02108	02098	02088	02078	02068	49	00050	00049	00047	00046	00044	00043
50	0.02058	02048	02038	02028	02018	02009	50	0.00041	00040	00039	00037	00036	00035
51	01999	01989	01979	01969	01960	01950	51	00033	00032	00031	00030	00029	00028
52	01940	01331	01921	01912	01902	01892	52	00026	00025	00024	00023	00022	00021
53	01883	01873	01864	01854	01845	01836	53	00020	00019	00018	00017	00017	00016
54	01826	01817	01808	01798	01789	01780	54	00015	00014	00013	00013	00012	00011
55	01771	01761	01752	01743	01734	01725	55	00010	00010	00009	00008	00008	00007
56	01716	01707	01698	01689	01680	01671	56	00007	00006	00005	00005	00005	00004
57	01662	01653	01644	01635	01626	01618	57	00004	00003	00003	00003	00002	00002
58	01609	01600	01591	01583	01574	01565	58	00002	00001	00001	00001	00001	00001
59	01557	01548	01540	01531	01523	01514	59	00000	00000	00000	00000	00000	00000

Middle Time.

	0 Hours.							1 Hour.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0	2.00000	16270	46373	63982	76476	86167	0	4.71403	71521	71638	71755	71872	71988
1	2.94085	00779	06578	11694	16269	20408	1	72104	72220	72335	72450	72565	72670
2	3.24187	27663	30882	33878	36681	39313	2	72793	72907	73020	73133	73246	73358
3	41796	44144	46371	48490	50510	52440	3	73470	73582	73694	73805	73916	74027
4	54289	56061	57764	59403	60982	62506	4	74137	74247	74357	74466	74575	74684
5	63978	65402	66781	68117	69413	70672	5	74792	74900	75008	75116	75223	75330
6	71895	73085	74242	75370	76469	77542	6	75437	75544	75650	75756	75862	75967
7	78588	79609	80607	81583	82537	83471	7	76072	76177	76281	76385	76489	76593
8	84385	85280	86157	87017	87860	88686	8	76697	76800	76903	77006	77108	77210
9	89498	90294	91076	91845	92600	93341	9	77312	77413	77514	77615	77716	77817
10	3.94071	94788	95494	96188	96872	97545	10	4.77917	78017	78117	78217	78316	78415
11	98207	98860	99503	00136	00761	01376	11	78514	78613	78711	78809	78907	79004
12	4.01983	02581	03172	03754	04329	04896	12	79101	79198	79295	79392	79488	79584
13	05456	06008	06554	07093	07626	08251	13	79680	79776	79871	79966	80061	80156
14	08671	09184	09691	10193	10688	11178	14	80251	80345	80439	80533	80627	80720
15	11663	12142	12616	13085	13549	14007	15	80813	80906	80999	81091	81183	81275
16	14461	14911	15355	15796	16231	16663	16	81367	81459	81550	81641	81732	81823
17	17090	17513	17932	18346	18757	19164	17	81914	82004	82094	82184	82274	82364
18	19567	19967	20363	20755	21143	21528	18	82453	82542	82631	82720	82808	82896
19	21910	22289	22664	23036	23405	23770	19	82984	83072	83160	83247	83334	83421
20	4.24333	24493	24849	25202	25553	25901	20	4.83508	83595	83682	83768	83854	83940
21	26246	26588	26928	27265	27599	27931	21	84026	84111	84196	84281	84366	84451
22	28260	28587	28911	29233	29553	29870	22	84536	84620	84704	84788	84872	84956
23	30185	30497	30807	31115	31421	31725	23	85039	85122	85205	85388	85371	85454
24	32026	32326	32623	32919	33212	33503	24	85536	85618	85700	85782	85864	85945
25	33793	34080	34365	34649	34931	35211	25	86026	86107	86188	86269	86350	86430
26	35489	35765	36040	36313	36584	36853	26	86510	86590	86670	86750	86830	86910
27	37121	37387	37651	37914	38175	38434	27	86989	87068	87147	87226	87304	87382
28	38692	38949	39204	39457	39709	39960	28	87460	87538	87616	87694	87772	87850
29	40209	40456	40702	40947	41190	41432	29	87927	88004	88081	88158	88235	88311
30	4.41673	41912	42150	42386	42622	42856	30	4.88387	88463	88539	88615	88691	88767
31	43088	43320	43550	43779	44007	44233	31	88842	88917	88992	89067	89142	89217
32	44459	44683	44906	45127	45348	45568	32	89291	89365	89439	89513	89587	89661
33	45786	46003	46219	46434	46648	46861	33	89735	89808	89881	89954	90027	90100
34	47073	47284	47494	47702	47910	48117	34	90173	90246	90318	90390	90462	90534
35	48323	48527	48731	48934	49136	49336	35	90606	90678	90750	90821	90892	90963
36	49536	49735	49933	50130	50326	50522	36	91034	91105	91176	91247	91317	91387
37	50716	50910	51102	51294	51485	51675	37	91457	91527	91597	91667	91737	91807
38	51864	52052	52240	52426	52612	52797	38	91876	91945	92014	92083	92152	92221
39	52981	53165	53347	53529	53710	53891	39	92290	92358	92426	92494	92562	92630
40	4.54070	54249	54427	54604	54780	54956	40	4.92698	92766	92834	92901	92968	93035
41	55131	55306	55479	55652	55824	55996	41	93102	93169	93236	93303	93369	93435
42	56166	56336	56506	56674	56842	57010	42	93501	93567	93633	93699	93765	93831
43	57177	57343	57508	57673	57837	58000	43	93897	93962	94027	94092	94157	94222
44	58163	58325	58487	58648	58808	58968	44	94287	94352	94417	94481	94545	94609
45	59127	59285	59443	59600	59751	59913	45	94673	94737	94801	94865	94929	94993
46	60069	60224	60378	60532	60685	60838	46	95056	95119	95182	95245	95308	95371
47	60990	61141	61292	61443	61593	61742	47	95434	95497	95559	95621	95683	95745
48	61891	62039	62187	62334	62481	62627	48	95807	95869	95931	95993	96055	96117
49	62773	62918	63063	63207	63351	63494	49	96178	96239	96300	96361	96422	96483
50	4.63637	63779	63921	64062	64203	64343	50	4.96544	96605	96665	96725	96785	96845
51	64483	64622	64761	64899	65037	65175	51	96906	96966	97026	97086	97145	97204
52	65312	65448	65584	65720	65855	65990	52	97264	97323	97383	97442	97501	97560
53	66125	66259	66392	66525	66658	66790	53	97618	97677	97736	97794	97853	97911
54	66922	67053	67184	67314	67444	67574	54	97969	98027	98085	98143	98201	98259
55	67703	67832	67961	68089	68217	68344	55	98316	98374	98431	98489	98546	98603
56	68471	68597	68723	68849	68974	69099	56	98660	98717	98774	98831	98887	98944
57	69224	69348	69472	69595	69718	69841	57	99000	99057	99113	99169	99225	99281
58	69963	70085	70207	70328	70449	70569	58	99337	99393	99448	99504	99559	99615
59	70689	70809	70928	71047	71166	71285	59	99670	99723	99780	99835	99890	99945

TABLE XXIII. For finding the Latitude by two Altitudes of the Sun.

Middle Time.

	2 Hours.							3 Hours.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0	5.00060	00055	00109	00164	00218	00272	0	5.15052	15083	15115	15146	15177	15209
1	00327	00381	00435	00489	00543	00596	1	15240	15271	15303	15334	15365	15396
2	00650	00704	00757	00810	00864	00917	2	15427	15458	15489	15520	15551	15582
3	00970	01023	01076	00129	01182	01234	3	15613	15643	15674	15705	15735	15766
4	01287	01339	01392	01444	01496	01549	4	15796	15827	15857	15888	15918	15948
5	01601	01653	01705	01757	01808	01860	5	15979	16009	16039	16069	16099	16129
6	01912	01963	02014	02066	02117	02168	6	16159	16189	16219	16249	16279	16309
7	02219	02270	02321	02372	02423	02473	7	16338	16368	16398	16427	16457	16486
8	02524	02574	02625	02675	02725	02776	8	16516	16545	16575	16604	16633	16662
9	02826	02876	02926	02976	03026	03075	9	16692	16721	16750	16779	16808	16837
10	5.03125	03174	03224	03275	03322	03372	10	5.16866	16895	16924	16953	16982	17010
11	03421	03470	03519	03568	03617	03665	11	17039	17068	17096	17125	17153	17182
12	03714	03763	03811	03859	03908	03956	12	17210	17239	17267	17296	17324	17352
13	04004	04052	04100	04148	04196	04244	13	17380	17408	17437	17465	17493	17521
14	04292	04340	04387	04435	04482	04530	14	17549	17577	17604	17632	17660	17688
15	04577	04624	04671	04718	04765	04812	15	17716	17743	17771	17798	17826	17854
16	04859	04906	04953	04999	05046	05092	16	17881	17908	17936	17963	17990	18018
17	05139	05185	05231	05278	05324	05370	17	18045	18072	18099	18126	18154	18181
18	05416	05462	05508	05553	05599	05645	18	18208	18235	18261	18228	18315	18342
19	05690	05736	05781	05827	05872	05917	19	18369	18395	18422	18449	18475	18502
20	5.05962	06007	06052	06097	06142	06187	20	5.18528	18555	18581	18608	18634	18660
21	06232	06276	06321	06365	06410	06454	21	18687	18713	18739	18765	18791	18818
22	06498	06543	06587	06631	06675	06619	22	18844	18870	18896	18922	18948	18973
23	06763	06807	06851	06894	06938	06981	23	18999	19025	19051	19076	19102	19128
24	07025	07068	07112	07155	07198	07241	24	19153	19179	19204	19230	19255	19281
25	07284	07328	07371	07413	07456	07499	25	19306	19331	19357	19382	19407	19432
26	07542	07584	07627	07670	07712	07754	26	19457	19483	19508	19533	19558	19583
27	07797	07839	07881	07923	07965	08007	27	19608	19632	19657	19682	19707	19732
28	08049	08091	08133	08175	08216	08258	28	19756	19781	19806	19831	19855	19879
29	08300	08341	08383	08424	08465	08507	29	19904	19928	19952	19977	20001	20025
30	5.08548	08589	08630	08671	08712	08753	30	5.20050	20074	20098	20122	20146	20170
31	08794	08834	08875	08916	08956	08997	31	20194	20218	20242	20266	20290	20314
32	09037	09078	09118	09158	09198	09239	32	20338	20362	20385	20409	29433	20456
33	09279	09319	09359	09399	09438	09478	33	20480	20504	20527	20551	20574	20597
34	09518	09558	09597	09637	09676	09716	34	20621	20644	20668	20691	20714	20737
35	09755	10794	09834	09873	09912	09951	35	20760	20784	20807	20830	20853	20876
36	09990	10029	10068	10107	10146	10184	36	20899	20922	20945	20967	20990	21013
37	10223	10262	10300	10339	10377	10416	37	21036	21059	21081	21104	21127	21149
38	10454	10492	10531	10569	10607	10645	38	21172	21194	21217	21239	21261	21284
39	10683	10721	10759	10797	10834	10872	39	21306	21329	21351	21373	21395	21417
40	5.10910	10947	10985	11022	11060	11097	40	5.21439	21462	21484	21506	21528	21550
41	11135	11172	11209	11246	11283	11320	41	21572	21593	21615	21637	21659	21681
42	11357	11394	11431	11468	11505	11542	42	21702	21724	21746	21767	21789	21810
43	11578	11615	11652	11688	11725	11761	43	21832	21853	21875	21896	21918	21939
44	11797	11834	11870	11906	11942	11979	44	21960	21982	22003	22024	22045	22067
45	12014	12050	12086	12122	12158	12194	45	22088	22109	22130	22151	22172	22193
46	12229	12265	12301	12336	12372	12407	46	22214	22235	22255	22276	22297	22318
47	12443	12478	12513	12549	12584	12619	47	22338	22359	22380	22400	22421	22442
48	12654	12689	12724	12759	12794	12829	48	22462	22483	22503	22524	22544	22564
49	12864	12898	12933	12968	13002	13037	49	22585	22605	22625	22645	22666	22686
50	5.13071	13106	13140	13175	13209	13243	50	5.22706	22726	22746	22766	22786	22806
51	13277	13311	13345	13379	13413	13447	51	22826	22846	22866	22886	22906	22925
52	13481	13515	13549	13583	13616	13650	52	22945	22965	22984	23004	23024	23043
53	13684	13717	13751	13784	13818	13851	53	23063	23082	23102	23121	23141	23160
54	13884	13917	13951	13984	14017	14050	54	23180	23199	23218	23238	23257	23276
55	14083	14116	14149	14182	14215	14247	55	23295	23314	23333	23352	23372	23391
56	14280	14313	14345	14378	14411	14443	56	23410	23429	23447	23466	23485	23504
57	14475	14508	14540	14573	14605	14637	57	23523	23542	23560	23579	23598	23616
58	14669	14701	14733	14765	14797	14829	58	23635	23654	23672	23691	23709	23728
59	14861	14893	14925	14957	14988	15020	59	23746	23765	23783	23801	23820	23838

Middle Time.

	4 Hours.							5 Hours.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0	5.23856	23874	23892	23911	23929	23947	0	5.28597	28606	28614	28623	28631	28639
1	23965	23983	24001	24019	24037	24055	1	28648	28656	28664	28673	28681	28689
2	24073	24091	24108	24126	24144	24162	2	28697	28705	28713	28722	28730	28738
3	24179	24197	24215	24232	24250	24267	3	28746	28754	28762	28770	28778	28786
4	24285	24302	24320	24337	24355	24372	4	28793	28801	28809	28817	28825	28833
5	24389	24407	24424	24441	24458	24476	5	28840	28848	28856	28863	28871	28879
6	24493	24510	24527	24544	24561	24578	6	28886	28894	28901	28909	28916	28924
7	24595	24612	24629	24646	24663	24680	7	28931	28939	28946	28953	28961	28968
8	24697	24714	24730	24747	24763	24780	8	28975	28983	28990	28997	29004	29012
9	24797	24813	24830	24846	24863	24879	9	29019	29026	29033	29040	29047	29054
10	5.24896	24912	24929	24945	24961	24978	10	5.29061	29068	29075	29082	29089	29096
11	24994	25010	25027	25043	25059	25075	11	29103	29110	29116	29123	29130	29137
12	25091	25107	25123	25139	25155	25171	12	29143	29150	29157	29163	29170	29177
13	25187	25203	25219	25235	25251	25266	13	29183	29190	29196	29203	29209	29216
14	25282	25298	25314	25329	25345	25360	14	29222	29219	29235	29241	29248	29254
15	25376	25392	25407	25423	25438	25454	15	29260	29267	29273	29279	29285	29292
16	25469	25484	25500	25515	25530	25546	16	29298	29304	29310	29316	29322	29328
17	25561	25576	25591	25607	25622	25637	17	29334	29340	29346	29352	29358	29364
18	25652	25667	25682	25697	25712	25727	18	29370	29375	29381	29387	29393	29399
19	25742	25757	25771	25786	25801	25816	19	29404	29410	29416	29421	29427	29433
20	5.25831	25845	25860	25875	25889	25904	20	5.29438	29444	29449	29455	29460	29466
21	25918	25933	25948	25962	25976	25991	21	29471	29477	29482	29487	29493	29498
22	26005	26020	26034	26048	26063	26077	22	29503	29509	29514	29519	29524	29529
23	26091	26105	26120	26134	26148	26162	23	29535	29540	29545	29550	29555	29560
24	26176	26190	26204	26218	26232	26246	24	29565	29570	29575	29580	29585	29590
25	26260	26274	26288	26301	26315	26329	25	29595	29599	29604	29609	29614	29619
26	26343	26357	26370	26384	26397	26411	26	29623	29628	29633	29637	29642	29647
27	26425	26438	26452	26465	26479	26492	27	29651	29656	29660	29665	29669	29674
28	26506	26519	26532	26546	26559	26572	28	29678	29683	29687	29691	29696	29700
29	26586	26599	26612	26625	26638	26651	29	29704	29709	29713	29717	29721	29726
30	5.26665	26678	26691	26704	26717	26730	30	5.29730	29734	29738	29742	29746	29750
31	26743	26755	26768	26781	26794	26807	31	29754	29758	29762	29766	29770	29774
32	26820	26832	26845	26858	26870	26883	32	29778	29782	29786	29790	29793	29797
33	26896	26908	26921	26933	26946	26958	33	29801	29805	29808	29812	29816	29819
34	26971	26983	26996	27008	27020	27033	34	29823	29827	29830	29834	29837	29841
35	27045	27057	27069	27082	27094	27106	35	29844	29848	29851	29854	29858	29861
36	27118	27130	27142	27154	27166	27178	36	29864	29868	29871	29874	29878	29881
37	27190	27202	27214	27226	27238	27250	37	29884	29887	29890	29893	29896	29900
38	27262	27274	27285	27297	27309	27320	38	29903	29906	29909	29912	29915	29918
39	27332	27344	27355	27367	27379	27390	39	29920	29923	29926	29929	29932	29935
40	5.27402	27418	27425	27436	27447	27459	40	5.29937	29940	29943	29946	29948	29951
41	27470	27481	27493	27504	27515	27526	41	29954	29956	29959	29961	29964	29966
42	27538	27549	27560	27571	27582	27593	42	29969	29971	29974	29976	29979	29981
43	27604	27615	27626	27637	27648	27659	43	29983	29986	29988	29990	29993	29995
44	27670	27681	27692	27703	27713	27724	44	29997	29999	30001	30004	30006	30008
45	27735	27746	27756	27767	27777	27788	45	30010	30012	30014	30016	30018	30020
46	27799	27809	27820	27830	27841	27851	46	30022	30024	30026	30028	30029	30031
47	27862	27872	27882	27893	27903	27913	47	30033	30035	30037	30038	30040	30042
48	27924	27934	27944	27954	27964	27975	48	30043	30045	30047	30048	30050	30051
49	27985	27995	28005	28015	28025	28035	49	30053	30054	30056	30057	30059	30060
50	5.28045	28055	28065	28075	28085	28094	50	5.30062	30063	30064	30066	30067	30068
51	28104	28114	28124	28134	28143	28153	51	30070	30071	30072	30073	30074	30075
52	28163	28172	28182	28191	28201	28211	52	30077	30078	30079	30080	30081	30082
53	28220	28230	28239	28249	28258	28267	53	30083	30084	30085	30086	30086	30087
54	28277	28286	28295	28305	28314	28323	54	30088	30089	30090	30090	30091	30092
55	28332	28342	28351	28360	28369	28378	55	30093	30093	30094	30095	30095	30096
56	28387	28396	28405	28414	28423	28432	56	30096	30097	30097	30098	30098	30099
57	28441	28450	28459	28468	28477	28485	57	30099	30100	30100	30100	30101	30101
58	28494	28503	28512	28520	28529	28538	58	30101	30102	30102	30102	30102	30102
59	28546	28555	28563	28572	28580	28589	59	30103	30103	30103	30103	30103	30103

Log Rising.

M	0 Hour. 0″	10″	20″	30″	40″	50″	M	1 Hour. 0″	10″	20″	30″	40″	50″
0	8.00000	42230	02436	37654	62642	82024	0	3.53243	53482	53721	53959	54197	54434
1	9.97860	11250	22848	33079	42230	50509	1	3.54670	54905	55140	55375	55608	55841
2	0.58066	65019	71455	77448	83054	88319	2	56074	56306	56537	56767	56997	57226
3	1.93284	67980	02435	06673	10714	14575	3	57455	57683	57910	58137	58363	58589
4	18271	21817	25224	28502	31660	34708	4	58814	59038	59262	59486	59708	59930
5	37653	40501	43258	45931	48524	51041	5	60152	60373	60593	60813	61032	61251
6	53488	55868	58184	60440	62639	64784	6	61469	61686	61908	62120	62336	62551
7	66877	68920	70917	72869	74778	76646	7	62766	62980	63194	63407	63620	63832
8	78474	80265	82019	83739	75426	87080	8	64043	64254	64465	64675	64885	65094
9	88703	90297	91862	93399	94909	96394	9	65302	65510	65717	65924	66131	66337
10	1.97854	99289	00699	02091	03458	04805	10	3.66542	66747	66952	67156	67359	67562
11	2.06131	07437	08723	09991	11240	12472	11	67765	67967	68168	68369	68570	68770
12	13687	14885	16066	17223	28382	19517	12	68969	69169	69367	69566	69763	69961
13	20638	21744	22836	23915	24980	26033	13	70157	70354	70550	70745	70940	71135
14	27073	28100	29116	30120	31112	32093	14	71329	71523	71716	71909	72101	72293
15	23063	24023	34972	35910	36839	37758	15	72485	72676	72867	73057	73247	73436
16	28667	29567	40457	41338	42211	43075	16	73625	73813	74001	74189	74376	74563
17	43930	44777	45616	46447	47270	48085	17	74750	74936	75121	75307	75491	75676
18	48893	49693	50486	51271	52050	52821	18	75860	76043	76227	76409	76952	76774
19	53586	54344	55096	55841	56580	57312	19	76955	77137	77318	77498	77678	77858
20	2.58039	58759	59473	60182	60885	61582	20	3.78037	78216	78395	78573	78750	78928
21	62274	62960	63641	64316	64987	65652	21	79105	79282	79458	79634	79809	79985
22	66312	66967	67617	68262	68903	69538	22	80159	80334	80508	80682	80855	81028
23	70169	70796	71418	72036	72649	73258	23	81201	81373	81545	81717	81888	82059
24	73863	74464	75060	75652	76241	76825	24	82230	82400	82570	82739	82908	83077
25	77405	77982	78555	79124	79689	80251	25	83246	83414	83582	83749	83917	84083
26	80809	81363	81914	82461	83005	83546	26	84250	84416	84582	84748	84913	85078
27	84083	84617	85148	25675	86199	86720	27	85242	85406	85570	85734	85897	86060
28	87238	87753	88265	88773	89279	89782	28	86223	86385	26547	86709	86870	87031
29	90282	90779	91273	91765	92254	92740	29	87192	87352	87513	87672	87832	87991
30	2.93223	93708	94181	94656	95129	95599	30	3.88150	88309	88467	88625	88783	88940
31	96067	96532	96994	97454	97912	98367	31	89097	89254	89411	89567	89723	89879
32	98820	99270	99718	00164	00608	01049	32	90034	90189	90344	90498	90653	90807
33	3.01488	01925	02360	02792	03223	03650	33	90960	91114	92167	91420	91572	91724
34	04077	04501	04922	05342	05760	06176	34	91876	92028	92179	92331	92482	92632
35	06590	07001	07411	07819	08225	08630	35	92782	92932	93082	93232	93381	93530
36	09032	09432	09830	10227	10622	11015	36	93679	93827	93975	94123	94271	94418
37	11406	11796	12184	12570	12954	13337	37	94566	94712	94859	95005	95151	95297
38	13718	14097	14475	14850	15225	15597	38	95443	95588	95733	95878	96023	96167
39	15969	16338	16706	17072	17437	17800	39	96311	96455	96599	96742	96885	97028
40	3.18162	18522	18881	19238	19594	19948	40	3.97170	97313	97455	97597	97738	97880
41	20303	20653	21003	21351	21698	22044	41	98021	98162	98302	98442	98583	98723
42	22389	22732	23073	23414	23753	24090	42	98862	99002	99141	99280	99419	99557
43	24423	24762	25095	25428	25759	26089	43	99696	99834	99972	00109	00247	00384
44	26418	26745	27072	27396	27720	28042	44	4.00521	00657	00793	00930	01066	01202
45	28366	28683	29002	29320	29637	29952	45	01337	01473	01608	01743	01877	02012
46	30266	30579	30891	31202	31512	31820	46	02146	02280	02414	02547	02681	02814
47	32128	32434	32739	33044	33347	33649	47	02947	03080	03212	03344	03477	03608
48	33950	34250	34549	34847	35144	35439	48	03740	03871	04003	04134	04265	04395
49	35734	36028	36321	36613	36903	37193	49	04526	04656	04786	04916	05045	05175
50	3.37482	37770	38057	38343	38628	38912	50	4.05304	05433	05561	05690	05818	05946
51	39195	39477	39759	40039	40318	40597	51	06074	06202	06330	06457	06584	06711
52	40875	41151	41427	41702	41976	42250	52	06838	06965	07091	07217	07343	07469
53	42523	42794	43064	43334	43603	43871	53	07595	07720	07845	07970	08095	08220
54	44138	44404	44670	44935	45199	45462	54	08344	08468	08592	08716	08840	08964
55	45724	45986	46247	46507	46765	47024	55	09087	09210	09333	09456	09578	09701
56	47282	47539	47795	48050	48305	48558	56	09823	09945	10067	10188	10310	10431
57	48811	49064	49315	49566	49816	50066	57	10552	10673	10794	10915	11035	11155
58	50314	50562	50809	51056	51301	51547	58	11275	11395	11515	11634	11754	11873
59	3.51791	52085	52278	52520	52761	53002	59	4.11992	12111	12229	12348	12466	12584

Log Rising.

M	2 Hours. 0″	10″	20″	30″	40″	50″	M	3 Hours. 0″	10″	20″	30″	40″	50″
0	4.12702	12820	12938	13055	13172	13289	0	4.46671	46747	46823	46899	46975	47051
1	13406	13523	13640	13756	13872	13988	1	47127	47203	47278	47354	47430	47505
2	14104	14220	14336	14451	14566	14682	2	47580	47656	47731	47806	47881	47956
3	14797	14911	15026	15140	15255	15369	3	48031	48106	48180	48255	48330	48404
4	15483	15597	15710	15824	15937	16050	4	48479	48553	48627	48701	48776	48850
5	16163	16276	16389	16501	16614	16726	5	48924	48998	49071	49145	49219	49293
6	16838	16950	17062	17173	17285	17396	6	49366	49440	49513	49586	49659	49733
7	17507	17618	17729	17839	17950	18060	7	49806	49879	49952	50025	50098	50170
8	18171	18281	18391	18500	18610	18719	8	50243	50316	50388	50461	50533	50605
9	18828	18938	19047	19156	19265	19373	9	50677	50750	50822	50894	50966	51038
10	4.19482	19590	19698	19806	19914	20021	10	4.51109	51181	51253	51325	51396	51467
11	20129	20236	20344	20451	20558	20665	11	51539	51610	51681	51753	51824	51895
12	20771	20878	20984	21091	21197	21303	12	51966	52037	52107	52178	52249	52319
13	21409	21514	21620	21725	21831	21936	13	52390	52461	52531	52601	52672	52742
14	22041	22146	22250	22355	22459	22564	14	52812	52882	52952	53022	53092	52162
15	22668	22772	22876	22980	23083	23187	15	53231	53301	53371	53440	53510	53579
16	23290	28393	23496	23599	23702	23805	16	53648	38718	53787	53856	53925	53994
17	23907	24010	24112	24214	24316	24418	17	54063	54132	54201	54269	54338	54407
18	24520	24622	24723	24825	24926	25027	18	54475	54544	54612	54680	54749	54817
19	25128	25229	25330	25430	25531	25631	19	54885	54953	55021	55089	55157	55225
20	4.25731	25831	25931	26031	26131	26231	20	4.55293	55360	55428	55496	55563	55630
21	26330	26429	26529	26628	26727	26826	21	55698	55765	55832	55900	55967	56034
22	26924	27023	27121	27220	27318	27416	22	56101	56168	56235	56301	56368	56435
23	27514	27612	27710	27807	27905	28002	23	56501	56568	56634	56701	56767	56834
24	28099	28197	28294	28391	28487	28584	24	56900	56966	57032	57098	57164	57230
25	28681	28777	28873	28969	29065	29162	25	57296	57362	57428	57494	57559	57625
26	29257	29353	29449	29544	29639	29735	26	57690	57756	57821	57886	57951	58017
27	29830	29925	30020	30115	30209	30304	27	58082	58147	58212	58277	58342	58407
28	30898	30493	30587	30681	30775	30869	28	58471	58536	58601	58665	58730	58794
29	30963	31056	31150	31248	31337	31430	29	58859	58923	58688	59052	59116	59180
30	4.31523	31616	31709	31801	31894	31987	30	4.59244	59308	59372	59436	59500	59564
31	32079	32171	32264	32356	32448	32540	31	59627	59691	59755	59818	59882	59945
32	32631	32723	32815	32906	32997	33089	32	60008	60072	60135	60198	60261	60324
33	33180	33271	33362	33453	33543	33634	33	60387	60450	60513	60576	60639	60701
34	33724	33815	33905	33995	34085	34175	34	60764	60827	60890	60952	61015	61077
35	34265	34355	34444	34534	34623	34713	35	61139	61202	61264	61326	61388	61450
36	34802	34891	34980	35069	35158	35247	36	61512	61574	61636	61698	61760	61822
37	35335	35424	35512	35601	35689	35777	37	61883	61945	62006	62068	62129	62191
38	35865	35953	36041	36128	36216	36303	38	62252	62313	62375	62436	62497	62558
39	36391	86478	36565	36653	36740	36827	39	62619	62680	62741	62802	62863	62923
40	4.36913	37000	37087	37173	37260	37346	40	4.62984	63045	63105	63166	63226	63287
41	37432	37518	37604	37690	37776	37862	41	63347	63407	63468	63528	63588	63648
42	37948	38033	38119	38204	38289	38374	42	63708	63768	63828	63888	63948	64008
43	38459	38544	38629	38714	38799	38884	43	64068	64127	64187	64246	64306	64365
44	38968	39052	39137	39221	39305	39389	44	64425	64484	64544	64603	64662	64721
45	39473	39557	39641	39725	39808	39892	45	64780	64839	64898	64957	65016	65075
46	39975	40058	40142	40225	40308	40391	46	65134	65193	65251	65310	65369	65427
47	40474	40556	40639	40722	40804	40886	47	65486	65544	65602	65661	65719	65777
48	40969	41051	41133	41215	41297	41379	48	65836	65895	65952	66010	66068	66126
49	41461	41542	41624	41706	41787	41868	49	66184	66241	66299	66357	66415	66472
50	4.41950	42031	42112	42193	42274	42355	50	4.66530	66588	66645	66702	66760	66817
51	42435	42516	42597	42677	42758	42838	51	66874	66932	66989	67046	67103	67160
52	42918	42998	43078	43158	43238	43318	52	67217	67274	67331	67388	67445	67502
53	43398	43477	43557	43636	43716	43795	53	67558	67615	67671	67728	67785	67841
54	43874	43953	44032	44111	44190	44269	54	67897	67954	68010	68066	68123	68179
55	44348	44426	44505	44583	44662	44740	55	68235	68291	68347	68403	68459	68515
56	44818	44896	44974	45052	45130	45208	56	68571	68627	68682	68738	68794	68849
57	45286	45363	45441	45518	45596	45673	57	68905	68960	69016	69071	69127	69182
58	45750	45827	45904	45981	46058	46135	58	69237	69292	69348	69403	69458	69513
59	4.46212	46289	46365	46442	46518	46595	59	4.69568	69623	69678	69733	69787	69842

Log Rising.

	4 Hours.							5 Hours.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0	4.69897	69952	70006	70061	70115	70170	0	4.86992	87034	87075	87116	87157	87198
1	70224	70279	70333	70387	70442	70496	1	87239	87280	87321	87362	87402	87443
2	70550	70604	70658	70712	70766	70820	2	87484	87525	87566	87606	87647	87688
3	70874	70928	70982	71036	71089	71143	3	87728	87769	87809	87850	87890	87931
4	71197	71250	71304	71357	71411	71464	4	87971	88012	88052	88093	88133	88173
5	71518	71571	71624	71678	71731	71784	5	88213	88254	88294	88334	88374	88414
6	71837	71890	71943	71996	72049	72102	6	88454	88494	88534	88574	88614	88654
7	72155	72208	72260	72313	72366	72418	7	88694	88734	88774	88814	88853	88893
8	72471	72523	72576	72628	72681	72733	8	88933	88973	89012	89052	89091	89131
9	72785	72838	72890	72942	72994	73046	9	89171	89210	89250	89289	89328	89368
10	4.73098	73150	73202	73254	73306	73358	10	4.89407	89447	89486	89525	89564	89604
11	73410	73462	73514	73565	73617	73668	11	89643	89682	89721	89760	89799	89838
12	73720	73772	73823	73874	73926	73977	12	89877	89916	89955	89994	90033	90072
13	74028	74080	74131	74182	74233	74284	13	90111	90149	90188	90227	90266	90305
14	74335	74386	74437	74488	74539	74590	14	90345	90382	90421	90459	90498	90536
15	74641	74692	74742	74793	74844	74894	15	90575	90613	90652	90690	90728	90767
16	74945	74995	75046	75096	75147	75197	16	90805	90843	90882	90920	90958	90996
17	75247	75298	75348	75398	75448	75498	17	91034	91073	91111	91149	91187	91225
18	75549	75599	75649	75699	75748	75798	18	91263	91301	91339	91377	91415	91452
19	75848	75898	75948	75997	76047	76097	19	91490	91528	91566	91603	91644	91679
20	4.76146	76196	76245	76295	76344	76394	20	4.91716	91754	91792	91830	91867	91904
21	76443	76492	76542	76591	76640	76689	21	91942	91979	9201[illegible]	92054	92092	92129
22	76738	76787	76836	76885	76934	76983	22	92166	92203	92241	92278	92315	92352
23	77032	77081	77130	77179	77227	77276	23	92390	92427	92464	92501	92538	92575
24	77325	77373	77422	77470	77519	77567	24	92612	92649	92686	92723	92760	92796
25	77616	77664	77713	77761	77809	77857	25	92833	92870	92907	92944	92980	93017
26	77906	77954	78002	78050	78098	78146	26	93054	93090	93127	93164	93200	93237
27	78194	78242	78290	78338	78385	78433	27	93273	93310	93346	93383	93419	93455
28	78481	78529	78576	78624	78671	78719	28	93492	93528	93564	93600	93637	93673
29	78767	78814	78861	78908	78956	79003	29	93709	93745	93781	93817	93854	93890
30	4.79051	79098	79145	79192	79240	79287	30	4.93926	93962	93998	94034	94069	94105
31	79334	79381	79428	79475	79522	79568	31	94141	94177	94213	94249	94284	94320
32	79615	79662	79709	79756	79802	79849	32	94356	94392	94427	94463	94498	94534
33	79896	79942	79989	80035	80082	80128	33	94570	94605	94641	94676	94712	94747
34	80175	80221	80267	80314	80360	80406	34	94782	94818	94853	94888	94924	94959
35	80452	80498	80544	80591	80637	80683	35	94994	95029	95065	95100	95135	95170
36	80729	80775	80820	80866	80912	80958	36	95205	95240	95275	95310	95345	95380
37	81004	81049	81095	81141	81186	81232	37	95415	95450	95485	95520	95555	95589
38	81277	81323	81368	81414	81459	81505	38	95624	95659	95694	95728	95763	95798
39	81505	81595	81641	81686	81731	81776	39	95832	95867	95902	95936	95971	96005
40	4.81821	81866	81911	81956	82001	82046	40	4.96040	96074	96109	96143	96177	96212
41	82091	82136	82181	82226	82271	82315	41	96246	96280	96315	96349	96383	96417
42	82360	82405	82449	82494	82538	82583	42	96451	96486	96520	96554	96588	96622
43	82628	82672	82716	82761	82805	82850	43	96656	96690	96724	96758	96792	96826
44	82894	82938	82982	83026	83071	83115	44	96860	96894	96927	96961	96995	97029
45	83159	83203	83247	83291	83335	83379	45	97062	97096	97130	97163	97197	97231
46	83423	83467	83510	83554	83598	83642	46	97264	97293	97331	97365	97398	97432
47	83685	83729	83773	83816	83860	83903	47	97465	97499	97532	97565	97599	97632
48	83947	83990	84034	84077	84120	84164	48	97665	97699	97732	97765	97798	97832
49	84207	84250	84293	84337	84380	84423	49	97865	97898	97931	97964	97997	98030
50	4.84466	84509	84552	84595	84638	84681	50	4.98063	98096	98129	98162	98195	98228
51	84724	84767	84810	84852	84895	84938	51	98261	98293	98326	98359	98392	98425
52	84981	85023	85066	85108	85151	85194	52	98457	98490	88523	98555	98588	98620
53	85236	85278	85321	85363	85406	85448	53	98653	98686	98718	98751	98783	98816
54	85490	85533	85575	85617	85659	85701	54	98848	98880	98913	98945	98978	99010
55	85744	85786	85828	85870	85912	85954	55	99042	99074	99107	99139	99171	99203
56	85996	86037	86079	86121	86163	86205	56	99235	99267	99300	99332	99364	99396
57	86246	86288	86330	86372	86413	86455	57	99428	99460	99492	99524	99556	99587
58	86496	86538	86579	86621	86662	86704	58	99619	99651	99683	99715	99747	99778
59	86745	86786	86828	86869	86910	86951	59	99810	99842	99873	99905	99937	99968

TABLE XXIII. For finding the Latitude by two Altitudes of the Sun.

Log Rising.

	6 Hours.							7 Hours.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0	0.00000	00031	00063	00094	00125	00156	0	5.09996	10020	10044	10068	10092	10116
1	00188	00219	00250	00282	00313	00345	1	10140	10164	10188	10212	10236	10260
2	00376	00407	00438	00469	00501	00532	2	10284	10808	10332	10356	10380	10404
3	00563	00595	00626	00657	00689	00720	3	10429	10453	10477	10501	10525	10549
4	00751	00782	00813	00844	00875	00905	4	10573	10596	10620	10643	10667	10691
5	00936	00967	00998	01028	01059	01090	5	10714	10738	10761	10785	10809	10832
6	01121	01151	01182	01213	01244	01275	6	10856	10879	10903	10926	10950	10974
7	01305	01336	01367	01398	01428	01459	7	10997	11021	11044	11068	11092	11115
8	01490	01520	01550	01580	01611	01641	8	11139	11162	11183	11208	11231	11255
9	01671	01701	01732	01762	01792	01822	9	11278	11301	11324	11347	11370	11393
10	5.01853	01883	01913	01943	01973	02004	10	5.11417	11440	11463	11486	11509	11532
11	02034	02064	02094	02125	02155	02185	11	11556	11570	11602	11625	11648	11671
12	02215	02245	02275	02304	02334	02364	12	11694	11717	11740	11763	11785	11808
13	02394	02423	02453	02483	02512	02542	13	11831	11854	11876	11899	11922	11945
14	02572	02602	02631	02661	02691	02720	14	11967	11990	12013	12036	12058	12080
15	02750	02780	02810	02839	02869	02899	15	12104	12126	12149	12172	12195	12217
16	02928	02958	02987	03016	03045	03074	16	12240	12263	12285	12307	12329	12352
17	03104	03133	03162	03191	03220	03250	17	12374	12396	12419	12441	12463	12486
18	03279	03308	03337	03366	03396	03425	18	12508	12530	12553	12575	12597	12619
19	03454	03483	03512	03542	03571	03600	19	12642	12664	12686	12709	12731	12753
20	5.03629	03658	03687	03715	03744	03773	20	5.12776	12798	12820	12841	12863	12885
21	03801	03830	03859	03887	03916	03945	21	12907	12929	12951	12973	13995	13017
22	03974	04002	04031	04060	04088	04117	22	13039	13061	13083	13104	13126	13148
23	04146	04174	04203	04232	04261	04289	23	13170	13192	13214	13236	13258	13280
24	04318	04346	04374	04402	04430	04459	24	13302	13323	13345	13366	13388	13409
25	04487	04515	04543	04571	04600	04628	25	13431	13452	13474	13495	13517	13538
26	04656	04684	04712	04740	04769	04797	26	13560	13581	13603	13624	13646	13667
27	04825	04853	04881	04910	04938	04966	27	13689	13711	13732	13753	13775	13796
28	04994	05022	05050	05077	05105	05133	28	13818	13839	13860	13881	13902	13923
29	05160	05188	05216	05243	05271	05299	29	13944	13966	13987	14008	14029	14050
30	5.05327	05354	05382	05410	05437	05465	30	5.14071	14092	14113	14134	14155	14176
31	05493	05520	05548	05576	05604	05631	31	14198	14219	14240	14261	14282	14303
32	05659	05686	05713	05740	05768	05795	32	14324	14345	14366	14386	14407	14428
33	05822	05849	05876	05904	05931	05958	33	14449	14469	14490	14511	14531	14552
34	05985	06013	06040	06067	06094	06122	34	14573	14593	14614	14635	14656	14676
35	06149	06176	06203	06230	06258	06285	35	14697	14718	14738	14759	14780	14800
36	06312	06339	06365	06392	06419	06445	36	14821	14842	14862	14882	14902	14923
37	06472	06499	06526	06553	06579	06606	37	14943	14963	14984	15004	15024	15045
38	06633	06660	06686	06713	06740	06766	38	15065	15085	15106	15126	15146	15166
39	06793	06820	06847	06873	06900	06927	39	15187	15207	15227	15248	15268	15288
40	5.06954	06980	07066	07033	07059	07085	40	5.15309	15329	15349	15869	15388	15408
41	07111	07138	07164	07190	07217	07243	41	15428	15448	15468	15488	15508	15528
42	07269	07295	07322	07348	07374	07400	42	15548	15568	15588	15608	15628	15648
43	07427	07453	07479	07505	07532	07558	43	15667	15687	15707	15727	15747	15767
44	07584	07610	07636	07662	07687	07713	44	15787	15807	15826	15846	15865	15885
45	07739	07765	07791	07816	07842	07868	45	15904	15924	15943	15963	16983	16002
46	07894	07920	07945	07971	07997	08023	46	16022	16041	16061	16080	16100	16119
47	08049	08074	08100	08126	08152	08178	47	16139	16158	16178	16197	16217	16237
48	08203	08229	08254	08280	08305	08330	48	16256	16275	16295	16314	16333	16352
49	08356	08381	08406	08432	08457	08482	49	16371	16390	16410	16429	16448	16467
50	5.08508	08533	08558	08584	08609	08634	50	5.16486	16505	16525	16544	16563	16582
51	08660	08685	08710	08736	08761	08787	51	16601	16620	16640	16659	16678	16697
52	08812	08837	08862	08887	08911	08936	52	16716	16735	16754	16773	16791	16810
53	08961	08986	09011	09036	09061	09086	53	16829	16848	16866	16885	16904	16923
54	09111	09136	09160	09185	09210	09235	54	16942	16960	16979	16998	17017	17036
55	09260	09285	09310	09335	09360	09385	55	17054	17073	17092	17111	17129	17148
56	09409	09434	09458	09483	09507	09532	56	17167	17185	17204	17222	17241	17259
57	09556	09581	09605	09629	09654	09678	57	17277	17296	17314	17333	17351	17369
58	09703	09727	09752	09776	09801	09825	58	17388	17406	17425	17443	17462	17480
59	5.09850	09874	09899	09923	09947	09972	59	17498	17517	17535	17554	17572	17590

Log Rising.

8 Hours.

M	0″	10″	20″	30″	40″	50″
0	5.17609	5.17627	5.17645	5.17663	5.17681	5.17699
1	5.17717	5.17735	5.17753	5.17772	5.17790	5.17808
2	5.17826	5.17844	5.17862	5.17880	5.17898	5.17916
3	5.17934	5.17952	5.17970	5.17988	5.18006	5.18024
4	5.18042	5.18060	5.18078	5.18095	5.18113	5.18131
5	5.18148	5.18166	5.18184	5.18202	5.18219	5.18237
6	5.18255	5.18272	5.18290	5.18308	5.18325	5.18343
7	5.18361	5.18378	5.18396	5.18414	5.18431	5.18449
8	5.18467	5.18484	5.18501	5.18519	5.18536	5.18553
9	5.18571	5.18588	5.18605	5.18623	5.18640	5.18657
10	5.18675	5.18692	5.18709	5.18727	5.18744	5.18761
11	5.18779	5.18796	5.18813	5.18831	5.18848	5.18865
12	5.18883	5.18900	5.18917	5.18934	5.18951	5.18968
13	5.18985	5.19002	5.19019	5.19035	5.19052	5.19069
14	5.19086	5.19103	5.19120	5.19137	5.19154	5.19171
15	5.19188	5.19205	5.19222	5.19239	5.19256	5.19273
16	5.19290	5.19307	5.19323	5.19340	5.19356	5.19373
17	5.19390	5.19406	5.19423	5.19440	5.19456	5.19473
18	5.19489	5.19506	5.19523	5.19539	5.16556	5.19572
19	5.19589	5.19606	5.19622	5.19639	5.19656	5.19672
20	5.19689	5.19705	5.19721	5.19738	5.19754	5.19770
21	5.19786	5.19803	5.19819	5.19835	5.19851	5.19868
22	5.19884	5.19900	5.19917	5.19933	5.19949	5.19965
23	5.19982	5.19998	5.20014	5.20030	5.20047	5.20063
24	5.20079	5.20095	5.20111	5.20127	5.20143	5.20159
25	5.20175	5.20191	5.20206	5.20222	5.20238	5.20254
26	5.20270	5.20286	5.20302	5.20318	5.20334	5.20350
27	5.20366	5.20382	5.20398	5.20413	5.20429	5.20445
28	5.20461	5.20477	5.20492	5.20508	5.20523	5.20539
29	5.20555	5.20570	5.20586	5.20601	5.20617	5.20633
30	5.20648	5.20664	5.20679	5.20695	5.20710	5.20726
31	5.20742	5.20757	5.20773	5.20788	5.20804	5.20819
32	5.20835	5.20850	5.20865	5.20881	5.20896	5.20911
33	5.20926	5.20943	5.20957	5.20972	5.20987	5.21002
34	5.21018	5.21033	5.21048	5.21063	5.21079	5.21094
35	5.21109	5.21124	5.21140	5.21155	5.21170	5.21185
36	5.21201	5.21215	5.21230	5.21245	5.21260	5.21275
37	5.21290	5.21305	5.21320	5.21335	5.21350	5.21364
38	5.21379	5.21394	5.21409	5.21424	5.21439	5.21454
39	5.21469	5.21484	5.21499	5.21513	5.21528	5.21543
40	5.21558	5.21573	5.21587	5.21602	5.21616	5.21631
41	5.21645	5.21660	5.21675	5.21689	5.21704	5.21718
42	5.21733	5.21747	5.21762	5.21777	5.21791	5.21806
43	5.21820	5.21835	5.21849	5.21864	5.21878	5.21893
44	5.21908	5.21922	5.21936	5.21950	5.21964	5.21979
45	5.21993	5.22007	5.22021	5.22036	5.22050	5.22064
46	5.22078	5.22092	5.22107	5.22121	5.22135	5.22149
47	5.22164	5.22178	5.22192	5.22206	5.22221	5.22235
48	5.22249	5.22263	5.22277	5.22291	5.22305	5.22318
49	5.22332	5.22346	5.22360	5.22374	5.22388	5.22402
50	5.22416	5.22430	5.22444	5.22457	5.22471	5.22485
51	5.22499	5.22513	5.22527	5.22541	5.22555	5.22569
52	5.22583	5.22596	5.22610	5.22623	5.22637	5.22650
53	5.22664	5.22678	5.22691	5.22705	5.22718	5.22732
54	5.22745	5.22759	5.22773	5.22786	5.22800	5.22813
55	5.22827	5.22840	5.22854	5.22868	5.22881	5.22895
56	5.22908	5.22921	5.22935	5.22948	5.22961	5.22974
57	5.22988	5.23001	5.23014	5.23027	5.23040	5.23054
58	5.23067	5.23080	5.23093	5.23107	5.23120	5.23133
59	5.23146	5.23160	5.23173	5.23186	5.23199	5.23213

Log Rising.

	6 Hours.							7 Hours.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0	0.00000	00031	00063	00094	00125	00156	0	5.09996	10020	10044	10068	10092	10116
1	00188	00219	00250	00282	00313	00345	1	10140	10164	10188	10212	10236	10260
2	00376	00407	00438	00469	00501	00532	2	10284	10808	10332	10356	10380	10404
3	00563	00595	00626	00657	00689	00720	3	10429	10453	10477	10501	10525	10549
4	00751	00782	00813	00844	00875	00905	4	10573	10596	10620	10643	10667	10691
5	00936	00967	00998	01028	01059	01090	5	10714	10738	10761	10785	10809	10832
6	01121	01151	01182	01213	01244	01275	6	10856	10879	10903	10926	10950	10974
7	01305	01336	01367	01398	01428	01459	7	10997	11021	11044	11068	11092	11115
8	01490	01520	01550	01580	01611	01641	8	11139	11162	11183	11208	11231	11255
9	01671	01701	01732	01762	01792	01822	9	11278	11301	11324	11347	11370	11393
10	5.01853	01883	01913	01943	01973	02004	10	5.11417	11440	11463	11486	11509	11532
11	02034	02064	02094	02125	02155	02185	11	11556	11570	11602	11625	11648	11671
12	02215	02245	02275	02304	02334	02364	12	11694	11717	11740	11763	11785	11808
13	02394	02423	02453	02483	02512	02542	13	11831	11854	11876	11899	11922	11945
14	02572	02602	02631	02661	02691	02720	14	11967	11990	12013	12036	12058	12020
15	02750	02780	02810	02839	02869	02899	15	12104	12126	12149	12172	12195	12217
16	02928	02958	02987	03016	03045	03074	16	12240	12263	12285	12307	12329	12352
17	03104	03133	03162	03191	03220	03250	17	12374	12396	12419	12441	12463	12486
18	03279	03308	03337	03366	03396	03425	18	12508	12530	12553	12575	12597	12619
19	03454	03483	03512	03542	03571	03600	19	12642	12664	12686	12709	12731	12753
20	5.03629	03658	03687	03715	03744	03773	20	5.12776	12798	12820	12841	12863	12885
21	03801	03830	03859	03887	03916	03945	21	12907	12929	12951	12973	13995	13017
22	03974	04002	04031	04060	04088	04117	22	13039	13061	13083	13104	13126	13148
23	04146	04174	04203	04232	04261	04289	23	13170	13192	13214	13236	13258	13280
24	04318	04346	04374	04402	04430	04459	24	13302	13323	13345	13366	13388	13409
25	04487	04515	04543	04571	04600	04628	25	13431	13452	13474	13495	13517	13538
26	04656	04684	04712	04740	04769	04797	26	13560	13581	13603	13624	13646	13667
27	04825	04853	04881	04910	04938	04966	27	13689	13711	13732	13753	13775	13796
28	04994	05022	05050	05077	05105	05133	28	13818	13839	13860	13881	13902	13923
29	05160	05188	05216	05243	05271	05299	29	13944	13966	13987	14008	14029	14050
30	5.05327	05354	05382	05410	05437	05465	30	5.14071	14092	14113	14134	14155	14176
31	05493	05520	05548	05576	05604	05631	31	14198	14219	14240	14261	14282	14303
32	05659	05686	05713	05740	05768	05795	32	14324	14345	14366	14386	14407	14428
33	05822	05849	05876	05904	05931	05958	33	14449	14469	14490	14511	14531	14552
34	05985	06013	06040	06067	06094	06122	34	14573	14593	14614	14635	14656	14676
35	06149	06176	06203	06230	06258	06285	35	14697	14718	14738	14759	14780	14800
36	06312	06339	06365	06392	06419	06445	36	14821	14842	14862	14882	14902	14923
37	06472	06499	06526	06553	06579	06606	37	14943	14963	14984	15004	15024	15045
38	96633	06660	06686	06713	06740	06766	38	15065	15085	15106	15126	15146	15166
39	06793	06820	06847	06873	06900	06927	39	15187	15207	15227	15248	15268	15288
40	5.06954	06980	07066	07033	07059	07085	40	5.15309	15329	15349	15369	15388	15408
41	07111	07138	07164	07190	07217	07243	41	15428	15448	15468	15488	15508	15528
42	07269	07295	07322	07348	07374	07400	42	15548	15568	15588	15608	15628	15648
43	07427	07453	07479	07505	07532	07558	43	15667	15687	15707	15727	15747	15767
44	07584	07610	07636	07662	07687	07713	44	15787	15807	15826	15846	15865	15885
45	07739	07765	07791	07816	07842	07868	45	15904	15924	15943	15963	16983	16002
46	07894	07920	07945	07971	07997	08023	46	16022	16041	16061	16080	16100	16119
47	08049	08074	08100	08126	08152	08178	47	16139	16158	16178	16197	16217	16237
48	08203	08229	08254	08280	08305	08330	48	16256	16275	16295	16314	16333	16352
49	08356	08381	08406	08432	08457	08482	49	16371	16390	16410	16429	16448	16467
50	5.08508	08533	08558	08584	08609	08634	50	5.16486	16505	16525	16544	16563	16582
51	08660	08685	08710	08736	08761	08787	51	16601	16620	16640	16659	16678	16697
52	08812	08837	08862	08887	08911	08936	52	16716	16735	16754	16773	16791	16810
53	08961	08986	09011	09036	09061	09086	53	16829	16848	16866	16885	16904	16923
54	09111	09136	09160	09185	09210	09235	54	16942	16960	16979	16998	17017	17036
55	09260	09285	09310	09335	09360	09385	55	17054	17073	17092	17111	17129	17148
56	09409	09434	09458	09483	09507	09532	56	17167	17185	17204	17222	17241	17259
57	09556	09581	09605	09629	09654	09678	57	17277	17296	17314	17333	17351	17369
58	09703	09727	09752	09776	09801	09825	58	17388	17406	17425	17443	17462	17480
59	5.09850	09874	09899	09923	09947	09972	59	17498	17517	17535	17554	17572	17590

Log Rising.

8 Hours.

M	0″	10″	20″	30″	40″	50″
0	5.17609	5.17627	5.17645	5.17663	5.17681	5.17699
1	5.17717	5.17735	5.17753	5.17772	5.17790	5.17808
2	5.17826	5.17844	5.17862	5.17880	5.17898	5.17916
3	5.17934	5.17952	5.17970	5.17988	5.18006	5.18024
4	5.18042	5.18060	5.18078	5.18095	5.18113	5.18131
5	5.18148	5.18166	5.18184	5.18202	5.18219	5.18237
6	5.18255	5.18272	5.18290	5.18308	5.18325	5.18343
7	5.18361	5.18378	5.18396	5.18414	5.18431	5.18449
8	5.18467	5.18484	5.18501	5.18519	5.18536	5.18553
9	5.18571	5.18588	5.18605	5.18623	5.18640	5.18657
10	5.18675	5.18692	5.18709	5.18727	5.18744	5.18761
11	5.18779	5.18796	5.18813	5.18831	5.18848	5.18865
12	5.18883	5.18900	5.18917	5.18934	5.18951	5.18968
13	5.18985	5.19002	5.19019	5.19035	5.19052	5.19069
14	5.19086	5.19103	5.19120	5.19137	5.19154	5.19171
15	5.19188	5.19205	5.19222	5.19239	5.19256	5.19273
16	5.19290	5.19307	5.19323	5.19340	5.19356	5.19373
17	5.19390	5.19406	5.19423	5.19440	5.19456	5.19473
18	5.19489	5.19506	5.19523	5.19539	5.16556	5.19572
19	5.19589	5.19606	5.19622	5.19639	5.19656	5.19672
20	5.19689	5.19705	5.19721	5.19738	5.19754	5.19770
21	5.19786	5.19803	5.19819	5.19835	5.19851	5.19868
22	5.19884	5.19900	5.19917	5.19933	5.19949	5.19965
23	5.19982	5.19998	5.20014	5.20030	5.20047	5.20063
24	5.20079	5.20095	5.20111	5.20127	5.20143	5.20159
25	5.20175	5.20191	5.20206	5.20222	5.20238	5.20254
26	5.20270	5.20286	5.20302	5.20318	5.20334	5.20350
27	5.20366	5.20382	5.20398	5.20413	5.20429	5.20445
28	5.20461	5.20477	5.20492	5.20508	5.20523	5.20539
29	5.20555	5.20570	5.20586	5.20601	5.20617	5.20633
30	5.20648	5.20664	5.20679	5.20695	5.20710	5.20726
31	5.20742	5.20757	5.20773	5.20788	5.20804	5.20819
32	5.20835	5.20850	5.20865	5.20881	5.20896	5.20911
33	5.20926	5.20943	5.20957	5.20972	5.20987	5.21002
34	5.21018	5.21033	5.21048	5.21063	5.21079	5.21094
35	5.21109	5.21124	5.21140	5.21155	5.21170	5.21185
36	5.21201	5.21215	5.21230	5.21245	5.21260	5.21275
37	5.21290	5.21305	5.21320	5.21335	5.21350	5.21364
38	5.21379	5.21394	5.21409	5.21424	5.21439	5.21454
39	5.21469	5.21484	5.21499	5.21513	5.21528	5.21543
40	5.21558	5.21573	5.21587	5.21602	5.21616	5.21631
41	5.21645	5.21660	5.21675	5.21689	5.21704	5.21718
42	5.21733	5.21747	5.21762	5.21777	5.21791	5.21806
43	5.21820	5.21835	5.21849	5.21864	5.21878	5.21893
44	5.21908	5.21922	5.21936	5.21950	5.21964	5.21979
45	5.21993	5.22007	5.22021	5.22036	5.22050	5.22064
46	5.22078	5.22092	5.22107	5.22121	5.22135	5.22149
47	5.22164	5.22178	5.22192	5.22206	5.22221	5.22235
48	5.22249	5.22263	5.22277	5.22291	5.22305	5.22318
49	5.22332	5.22346	5.22360	5.22374	5.22388	5.22402
50	5.22416	5.22430	5.22444	5.22457	5.22471	5.22485
51	5.22499	5.22513	5.22527	5.22541	5.22555	5.22569
52	5.22583	5.22596	5.22610	5.22623	5.22637	5.22650
53	5.22664	5.22678	5.22691	5.22705	5.22718	5.22732
54	5.22745	5.22759	5.22773	5.22786	5.22800	5.22813
55	5.22827	5.22840	5.22854	5.22868	5.22881	5.22895
56	5.22908	5.22921	5.22935	5.22948	5.22961	5.22974
57	5.22988	5.23001	5.23014	5.23027	5.23040	5.23054
58	5.23067	5.23080	5.23093	5.23107	5.23120	5.23133
59	5.23146	5.23160	5.23173	5.23186	5.23199	5.23213

TABLE XXIV. OF NATURAL SINES.

	0°		1°		2°		3°		4°		
M	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sin	N cos.	N sine	N cos	M
0	00	100000	1745	99985	3490	99939	5234	99863	6976	99756	60
1	29	100000	1774	99984	3519	99938	5263	99861	7005	99754	59
2	58	100000	1803	99984	3548	99937	5292	99860	7034	99752	58
3	87	100000	1832	99983	3577	99936	5321	99858	7063	99750	57
4	116	100000	1862	99983	3606	99935	5350	99857	7092	99748	56
5	145	100000	1891	99982	3635	99934	5379	99855	7121	99746	55
6	175	100000	1920	99982	3664	99933	5408	99854	7150	99744	54
7	204	100000	1949	99981	3693	99932	5437	99852	7179	99742	53
8	233	100000	1978	99980	3723	99931	5466	99851	7208	99740	52
9	262	100000	2007	99980	3752	99930	5495	99849	7237	99738	51
10	291	100000	2036	99979	3781	99929	5524	99847	7266	99736	50
11	320	99999	2065	99979	3810	99927	5553	99846	7295	99734	49
12	349	99999	2094	99978	3839	99926	5582	99844	7324	99631	48
13	378	99999	2123	99977	3868	99925	5611	99842	7353	99729	47
14	407	99999	2152	99977	3897	99924	5640	99841	7382	99727	46
15	436	99999	2181	99976	3926	99923	5669	99839	7411	99725	45
16	465	99999	2211	99976	3955	99922	5698	99838	7440	99723	44
17	495	99999	2240	99975	3984	99921	5727	99836	7469	99721	43
18	524	99999	2269	99974	4013	99919	5756	99834	7498	99719	42
19	553	99998	2298	99974	4042	99918	5785	99833	7527	99716	41
20	582	99998	2327	99973	4071	99917	5814	99531	7556	99714	40
21	611	99998	2356	99972	4100	99916	5844	99829	7585	99712	39
22	640	99998	2385	99972	4129	99915	5873	99827	7614	99710	38
23	669	99998	2414	99971	4159	99913	5902	99826	7643	99708	37
24	698	99998	2443	99970	4188	99912	5931	99824	7672	99705	36
25	727	99997	2472	99969	4217	99911	5960	99822	7701	99703	35
26	756	99997	2501	99969	4246	99910	5989	99821	7730	99701	34
27	785	99997	2530	99968	4275	99909	6018	99819	7759	99699	33
28	814	99997	2560	99967	4304	99907	6047	99817	7788	99696	32
29	844	99996	2589	99966	4333	99906	6076	99815	7817	99694	31
30	873	99996	2618	99966	4362	99905	6105	99313	7846	99692	30
31	902	99996	2647	99965	4391	99904	6134	99812	7875	99689	29
32	931	99996	2676	99964	4420	99902	6163	99810	7904	99687	25
33	960	99995	2705	99963	4449	99901	6192	99808	7933	99685	27
34	989	99995	2734	99963	4478	99900	6221	99806	7962	99683	26
35	1018	99995	2763	99962	4507	99898	6250	99804	7991	99680	25
36	1047	99995	2792	99961	4536	99897	6279	99803	8020	99678	24
37	1076	99994	2821	99960	4565	99896	6308	99801	8049	99676	23
38	1105	99994	2850	99959	4594	99894	6337	99799	8078	99673	22
39	1134	99994	2879	99959	4623	99893	6366	99797	8107	99671	21
40	1164	99993	2908	99958	4653	99892	6395	99795	8136	99668	20
41	1193	99993	2938	99957	4682	99890	6424	99793	8165	99666	19
42	1222	99993	2967	99956	4711	99889	6453	99792	8194	99664	18
43	1251	99992	2996	99955	4740	99888	6482	99790	8223	99661	17
44	1280	99992	3025	99954	4769	99886	6511	99788	8252	99659	16
45	1309	99991	3054	99953	4798	99885	6540	99786	8281	99657	15
46	1338	99991	3083	99952	4827	99883	6569	99784	8310	99654	14
47	1367	99991	3112	99952	4856	99882	6598	99782	8339	99652	13
48	1396	99990	3141	99951	4885	99881	6627	99720	8368	99649	12
49	1425	99990	3170	99950	4914	99879	6656	99778	8397	99647	11
50	1454	99989	3199	99949	4943	99878	6685	99776	8426	99644	10
51	1483	99989	3228	99948	4972	99876	6714	99774	8455	99642	9
52	1513	99989	3257	99947	5001	99875	6743	99772	8484	99639	8
53	1542	99988	3286	99946	5030	99873	6773	99770	8513	99937	7
54	1571	99988	3316	99945	5059	99872	6802	99768	8542	99635	6
55	1600	99987	3345	99944	5088	99870	6831	99766	8571	99632	5
56	1629	99987	3374	99943	5117	99869	6860	99764	8600	99630	4
57	1658	99986	3403	99942	5146	99867	6889	99762	8629	99627	3
58	1687	99986	3432	99941	5175	99866	6918	99760	8658	99625	2
59	1716	99985	3461	99940	5205	99864	6947	99758	8687	99622	1
60	1745	99985	3490	99939	5234	99863	6976	99756	8716	99619	0
M	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	M

TABLE XXIV. Of Natural Sines.

	5°		6°		7°		8°		9°		
M	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	M
0	8716	99619	10453	99452	12187	99255	13917	99027	15643	98769	60
1	8745	99617	10482	99449	12216	99251	13646	99023	15672	98764	59
2	8774	96614	10511	99446	12245	99248	13975	99019	15701	98760	58
3	8803	99612	10540	99443	12274	99244	14004	99015	15730	98755	57
4	8831	99609	10569	99440	12302	99240	14033	99011	15758	98751	56
5	8860	99607	10597	99437	12331	99237	14061	99006	15787	98746	55
6	8889	99604	10626	99434	12360	99233	14090	99002	15816	98741	54
7	8918	99602	10655	99431	12389	99230	14119	98998	15845	98737	53
8	8947	99599	10684	99428	12418	99226	14148	98994	15873	98732	52
9	8976	99596	10713	99424	12447	99222	14177	98990	15902	98728	51
10	9005	99594	10742	99421	12476	99219	14205	98986	15931	98723	50
11	9034	99591	10771	99418	12504	99215	14234	98982	15959	98718	49
12	9063	99588	10800	99415	12533	99211	14263	98978	15988	98714	48
13	9092	99586	10829	99412	12562	99208	14292	98973	16017	98709	47
14	9121	99583	10858	99409	12591	99204	14320	98969	16046	98704	46
15	9150	99580	10887	99406	12620	99200	14349	98965	16074	98700	45
16	9179	99578	10916	99402	12649	99197	14378	98961	16103	98695	44
17	9208	99575	10945	99399	12678	99193	14407	98957	16132	98690	43
18	9237	99572	10973	99396	12706	99189	14436	98953	16160	98686	42
19	9266	99570	11002	99393	12735	99186	14464	98948	16189	98681	41
20	9295	99567	11031	99390	12764	99182	14493	98944	16218	98676	40
21	9324	99564	11060	99386	12793	99178	14522	98940	16246	98671	39
22	9353	99562	11089	99383	12822	99175	14551	98936	16275	98667	38
23	9382	99559	11118	99380	12851	99171	14580	98931	16304	98662	37
24	9411	99556	11147	99377	12880	99167	14608	98927	16333	98657	36
25	9440	99553	11176	99374	12908	99163	14637	98923	16361	98652	35
26	9469	99551	11205	99370	12937	99160	14666	98919	16390	98648	34
27	9498	99548	11234	99367	12966	99156	14695	98914	16419	98643	33
28	9527	99545	11263	99364	12995	99152	14723	98910	16447	98638	32
29	9556	99542	11291	99360	13024	99148	14752	98906	16476	98633	31
30	9585	99540	11320	99357	13053	99144	14781	98902	16505	98629	30
31	9614	99537	11349	99354	13081	99141	14810	98897	16533	98624	29
32	9642	99534	11378	99351	13110	99137	14838	98893	16562	98619	28
33	9671	99531	11407	99347	13139	99133	14867	98889	16591	98614	27
34	9700	99528	11436	99344	13168	99129	14896	98884	16620	98609	26
35	9729	99526	11465	99341	13197	99125	14925	98880	16648	98604	25
36	9758	99523	11494	99337	13226	99122	14954	98876	16677	98600	24
37	9787	99520	11523	99334	13254	99118	14982	98871	16706	98595	23
38	9816	99517	11552	99331	13283	99114	15011	98867	16734	98590	22
39	9845	99514	11580	99327	13312	99110	15040	98863	16763	98585	21
40	9874	99511	11609	99324	13341	99106	15069	98858	16792	98580	20
41	9903	99508	11638	99320	13370	99102	15097	98854	16820	98575	19
42	9932	99506	11667	99317	13399	99098	15126	98849	16849	98570	18
43	9961	99503	11696	99314	18427	99094	15155	98845	16878	98565	17
44	9990	99500	11725	99310	13456	99091	15184	98841	16906	98561	16
45	10019	99497	11754	99307	13485	99087	15212	98836	16935	98556	15
46	10048	99494	11783	99303	13514	99083	15241	98832	16964	98551	14
47	10077	99491	11812	99300	13543	99079	15270	98827	16992	98546	13
48	10106	99488	11840	99297	13572	99075	15299	98823	17021	98541	12
49	10135	99485	11869	99293	13600	99071	15327	98818	17050	98536	11
50	10164	99482	11898	99290	13629	99067	15356	98814	17078	98531	10
51	10192	99479	11927	99286	13658	99063	15385	98809	17107	98526	9
52	10221	99476	11956	99283	13687	99059	15414	98805	17136	98521	8
53	10250	99473	11985	99279	13716	99055	15442	98800	17164	98516	7
54	10279	99470	12014	99276	13744	99051	15471	98796	17193	98511	6
55	10308	99467	12043	99272	13773	99047	15500	98791	17222	98506	5
56	10337	99464	12071	99269	13802	99043	15529	98787	17250	98502	4
57	10366	99461	12100	99265	13831	99039	15557	98782	17279	98496	3
58	10395	99458	12129	99262	13860	99035	15586	98778	17308	98491	2
59	10424	99455	12158	99258	13889	99031	15615	98773	17336	98486	1
60	10453	99452	12187	99255	13917	99027	15643	98769	17365	98481	0
M	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	M
	84°		83°		82°		81°		80°		

M	10° N sine	10° N cos.	11° N sine	11° N cos.	12° N sine	12° N cos.	13° N sine	13° N cos.	41° N sine	41° N cos.	M
0	17365	98481	19081	98163	20791	97815	22495	97437	24192	97030	60
1	17393	98476	19109	98157	20820	97809	22523	97430	24220	97023	59
2	17422	98471	19138	98152	20848	97803	22552	97424	24249	97015	58
3	17451	98466	19167	98146	20877	97797	22580	97417	24277	97008	57
4	17479	98461	19195	98140	20905	97791	22608	97411	21305	97001	56
5	17508	98455	19224	98135	20938	97784	22637	97404	24333	96994	55
6	17537	98450	19252	98129	20962	97778	22665	97398	24362	96987	54
7	17565	98445	19281	98124	20990	97772	22693	97391	24390	96980	53
8	17594	98440	19309	98118	21019	97766	22722	97384	24418	96973	52
9	17623	98435	19338	98112	21047	97760	22750	97378	24446	96966	51
10	17651	98430	19366	98107	21076	97754	22778	97371	24474	96959	50
11	17680	98425	19395	93101	21104	97748	22807	97365	24503	96952	49
12	17708	98420	19423	98096	21132	97742	22835	97358	24531	96945	48
13	17737	98414	19452	98090	21161	97735	22863	97351	24559	96937	47
14	17766	98409	19481	98084	21189	97729	22892	97345	24587	96930	46
15	17794	98404	19509	98079	21218	97723	22920	97338	24615	96923	45
16	17823	98399	19538	98073	21246	97717	22948	97331	24644	96916	44
17	17852	98394	19566	98067	21275	97711	22977	97325	24672	96909	43
18	17880	98389	19595	98061	21303	97705	23005	97318	24700	96902	42
19	17909	98303	19623	98056	21331	97698	23033	97311	24728	96894	41
20	17937	98378	19652	98050	21360	97692	23062	97304	24756	96887	40
21	17966	98373	19680	98044	21388	97686	23090	97298	24784	96880	39
22	17995	98368	19709	98039	21417	97680	23118	97291	24813	96873	38
23	18023	98362	19737	98033	21445	97673	23146	97284	24841	96866	37
24	18052	98357	19766	98027	21474	97667	23175	97278	24869	96858	36
25	18080	98352	19794	98021	21502	97661	23203	97271	24897	96851	35
26	18109	98347	19823	98016	21530	97655	23231	97264	24925	96844	34
27	18138	98341	19851	98010	21559	97648	23260	97257	24953	96837	33
28	18166	98336	19880	98004	21587	97642	23288	97251	24982	96829	32
29	18195	98331	19908	97998	21616	97636	23316	97244	25010	96822	31
30	18224	98325	19937	97992	21644	97630	23345	97237	25038	96815	30
31	18252	98320	19965	97987	21672	97623	23373	97230	25066	96807	29
32	18281	98315	19994	97981	21701	97617	23401	97223	25094	96800	28
33	18309	98310	20022	97975	21729	97611	23429	97217	25122	96793	27
34	18338	98304	20051	97969	21758	97604	23458	97210	25151	96786	26
35	18367	98299	20079	97963	21786	97598	23486	97203	25179	96778	25
36	18395	98294	20108	97958	21814	97592	23514	97196	25207	96771	24
37	18424	98288	20136	97952	21843	97585	23542	97189	25235	96764	23
38	18452	98283	20165	97946	21871	97579	23571	97182	25263	96756	22
39	18481	98277	20193	97940	21899	97573	23599	97176	25291	96749	21
40	18509	98272	20222	97934	21928	97566	23627	97169	25320	96742	20
41	18538	98267	20250	97928	21956	97560	23656	97162	25348	96734	19
42	18567	98261	20279	97922	21985	97553	23684	97155	25376	96727	18
43	18595	98256	20307	97916	22013	97547	23712	97148	25404	96719	17
44	18624	98250	20336	97910	22041	97541	23740	97141	25432	96712	16
45	18652	98245	20364	97905	22070	97534	23769	97134	25460	96705	15
46	18681	98240	20393	97899	22098	97528	23797	97127	25488	96697	14
47	18710	98234	20421	97893	22126	97521	23825	97120	25516	96690	13
48	18738	98229	20450	97887	22155	97515	23853	97113	25545	96682	12
49	18767	98223	20478	97881	22183	97508	23882	97106	25573	96675	11
50	18795	98218	20507	97875	22212	97502	23910	97100	25601	96667	10
51	18824	98212	20535	97869	22240	97496	23938	97093	25629	96660	9
52	18852	98207	20563	97863	22268	97489	23966	97086	25657	96653	8
53	18881	98201	20592	97857	22297	97483	23995	97079	25685	96645	7
54	18910	98196	20620	97851	22325	97476	24023	97072	25713	96638	6
55	18938	98190	20649	97845	22353	97470	24051	97065	25741	96630	5
56	18967	98185	20677	97839	22382	97463	24079	97058	25769	96623	4
57	18995	98179	20706	97833	22410	97457	24108	97051	25798	96615	3
58	19024	98174	20734	97827	22438	97450	24136	97044	25826	96608	2
59	19052	98168	20763	97821	22467	97444	24164	97037	25854	96600	1
60	19081	98163	20791	97815	22495	97437	24192	97030	25882	96592	0
M	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	M
	79°		78°		77°		76°		75°		

	15°		16°		17°		18°		19°		
M	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	M
0	25882	96593	27564	96126	29237	95630	30902	95106	32557	94552	60
1	25910	96585	27592	96118	29265	95622	30929	95097	32584	94542	59
2	25938	96578	27620	96110	29293	95613	30957	95088	32612	94533	58
3	25966	96570	27648	96102	29321	95605	30985	95079	32639	94523	57
4	25994	96562	27676	96094	29348	95596	31012	95070	32667	94514	56
5	26022	96555	27704	96086	29376	95588	31040	95061	32694	94504	55
6	26050	96547	27731	96078	29404	95579	31068	95052	32722	94495	54
7	26079	96540	27759	96070	29432	95571	31095	95043	32749	94485	53
8	26107	96532	27787	96062	29460	95562	31123	95033	32777	94476	52
9	26135	96524	27815	96054	29487	95554	31151	95024	32804	94466	51
10	26163	96517	27843	96046	29515	95545	31178	95015	32832	94457	50
11	26191	96509	27871	96037	29543	95536	31206	95006	32859	94447	49
12	26219	96502	27899	96029	29571	95528	31233	94997	32887	94438	48
13	26247	96494	27927	96021	29599	95519	31261	94988	32914	94428	47
14	26275	96486	27955	96013	29626	95511	31289	94979	32942	94418	46
15	26303	96479	27983	96005	29654	95502	31316	94970	32969	94409	45
16	26331	96471	28011	95997	29682	95493	31344	94961	32997	94399	44
17	26359	96463	28039	95989	29710	95485	31372	94952	33024	94390	43
18	26387	96456	28067	95981	29737	95476	31399	94943	33051	94380	42
19	26415	96448	28095	95972	29765	95467	31427	94933	33079	94370	41
20	26443	96440	28123	95964	29793	95459	31454	94924	33106	94361	40
21	26471	96433	28150	95956	29821	95450	31482	94915	33134	94351	39
22	26500	96425	28178	95948	29849	95441	31510	94906	33161	94342	38
23	26528	96417	28206	95940	29876	95433	31537	94897	33189	94332	37
24	26556	96410	28234	95931	29904	95424	31565	94888	33216	94322	36
25	26584	96402	28262	95923	29932	95415	31593	94878	33244	94313	35
26	26612	96394	28290	95915	29960	95407	31620	94869	33271	94303	34
27	26640	96386	28318	95907	29987	95398	31648	94860	33298	94293	33
28	26668	96379	28346	95898	30015	95389	31675	94851	33326	94284	32
29	26696	96371	28374	95890	30043	95380	31703	94842	33353	94274	31
30	26724	96363	28402	95882	30071	95372	31730	94832	33381	94264	30
31	26752	96355	28429	95874	30098	95363	31758	94823	33408	94254	29
32	26780	96347	28457	95865	30126	95354	31786	94814	33436	94245	28
33	26808	96340	28485	95857	30154	95345	31813	94805	33463	94235	27
34	26836	96332	28513	95849	30182	95337	31841	94795	33490	94225	26
35	26864	96324	28541	95841	30209	95323	31868	94786	33518	94215	25
36	26892	96316	28569	95832	30237	95319	31896	94777	33545	94206	24
37	26920	96308	28597	95824	30265	95310	31923	94768	33573	94196	23
38	26948	96301	28625	95816	30292	95301	31951	94758	33600	94186	22
39	26976	96293	28652	95807	30320	95293	31979	94749	33627	94176	21
40	27004	96285	28680	95799	30348	95284	32006	94740	33655	94167	20
41	27032	96277	28708	95791	30376	95275	32034	94730	33682	94157	19
42	27060	96269	28736	95782	30403	95266	32061	94721	33710	94147	18
43	27088	96261	28764	95774	30431	95257	32089	94712	33737	94137	17
44	27116	96253	28792	95766	30459	95248	32116	94702	33764	94127	16
45	27144	96246	28820	95757	30486	95240	32144	94693	33792	94118	15
46	27172	96238	28847	95749	30514	95231	32171	94684	33819	94108	14
47	27200	96230	28876	95740	30542	95222	32199	94674	33846	94098	13
48	27228	96222	28903	95732	30570	95213	32227	94665	33874	94088	12
49	27256	96214	28931	95724	30597	95204	32254	94656	33901	94078	11
50	27284	96206	28959	95715	30625	95195	32282	94646	33929	94068	10
51	27312	96198	28987	95707	30653	95186	32309	94637	33956	94058	9
52	27340	96190	29015	95698	30680	95177	32337	94627	33983	94049	8
53	27368	96182	29042	95690	30708	95168	32364	94618	34011	94039	7
54	27396	96174	29070	95681	30736	95159	32392	94609	34038	94029	6
55	27424	96160	29098	95673	30763	95150	32419	94599	34065	94019	5
56	27452	96158	29126	95664	30791	95142	32447	94590	34093	94009	4
57	27480	96150	29154	95656	30819	95133	32474	94580	34120	93999	3
58	27508	96142	29182	95647	30846	95124	32502	94571	34147	93989	2
59	27536	96134	29209	95639	30874	95115	32529	94561	34175	93979	1
60	27564	96126	29237	95630	30902	95106	32557	94552	34202	93969	0
M	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	M
	74°		73°		72°		71°		70°		

	20°		21°		22°		23°		24°		
M	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	M
0	34202	93969	35837	93358	37461	92718	39073	92050	40674	91355	60
1	34229	93959	35864	93348	37488	92707	39100	92039	40700	91343	59
2	34257	93949	35891	93337	37515	92697	39127	92028	40727	91331	58
3	34284	93939	35918	93327	37542	92686	39153	92016	40753	91319	57
4	34311	93929	35645	93316	37569	92675	39180	92005	40780	91307	56
5	34336	93919	35973	93306	37595	92664	39207	91994	40806	91295	55
6	34366	93909	36000	93295	37622	92653	39234	91982	40833	91283	54
7	34393	93899	36027	93285	37649	92642	39260	91971	40860	91272	53
8	34421	93889	36054	93274	37676	92631	39287	91959	40886	91260	52
9	34448	93879	36081	93264	37703	92620	39314	91948	40913	91248	51
10	34475	93869	36108	93253	37730	92609	39341	91936	40939	91236	50
11	34503	93859	36135	93243	37757	92598	39367	91925	40966	91224	49
12	34530	93849	36162	93232	37784	92587	39394	91914	40992	91212	48
13	34557	93839	36190	93222	37811	92576	39421	91902	41019	91200	47
14	34584	93829	36217	93211	37838	92565	39448	91891	41045	91188	46
15	34612	93819	36244	93201	37865	92554	39474	91879	41072	91176	45
16	34639	93809	36271	93190	37892	92543	39501	91868	41098	91164	44
17	34666	93799	36298	93180	37919	92532	39528	91856	41125	91152	43
18	34694	93789	36325	93169	37946	92521	39555	91845	41151	91140	42
19	34721	93779	36352	93159	37973	92510	39581	91833	41178	91128	41
20	34748	93769	36379	93148	37999	92499	39608	91822	41204	91116	40
21	34775	93759	36406	93137	38026	92488	39635	91810	41231	91104	39
22	34803	93748	36434	93127	38053	92477	39661	91799	41257	91092	38
23	34830	93738	36461	93116	38080	92466	39688	91787	41284	91080	37
24	34857	93728	36488	93106	38107	92455	39715	91775	41310	91068	36
25	34884	93718	36515	93095	38134	92444	39741	91764	41337	91056	35
26	34912	93708	36542	93084	38161	92432	39768	91752	41363	91044	34
27	34939	93698	36569	93074	38188	92421	39795	91741	41390	91032	33
28	34966	93688	36596	93063	38215	92410	39822	91729	41416	91020	32
29	34993	93677	36623	93052	38241	92399	39848	91718	41443	91008	31
30	35021	93667	36650	93042	38268	92388	39875	91706	41469	90996	30
31	35048	93657	36677	93031	38295	92377	39902	91694	41496	90984	29
32	35075	93647	36704	93020	38322	92366	39928	91683	41522	90972	28
33	35102	93637	36731	93010	38349	92355	39955	91671	41549	90960	27
34	35130	93626	36758	92999	38376	92343	39982	91660	41575	90948	26
35	35157	93616	36785	92998	38403	92332	40008	91648	41602	90936	25
36	35184	93606	36812	92978	38430	92321	40035	91636	41628	90924	24
37	35211	93596	36839	92967	38456	92310	40062	91625	41655	90911	23
38	35239	93585	36867	92956	38483	92299	40088	91613	41681	90899	22
39	35266	93575	36894	92945	38510	92287	40115	91601	41707	90887	21
40	35293	93565	36921	92935	38537	92276	40141	91590	41734	90875	20
41	35320	93555	36948	92924	38564	92265	40168	91578	41760	90863	19
42	35347	93544	36975	92913	38591	92254	40195	91566	41787	90851	18
43	35375	93534	37002	92902	38617	92245	40221	91555	41813	90839	17
44	35402	93524	37029	92892	38644	92231	40248	91543	41840	90826	16
45	35429	93514	37056	92881	38671	92220	40275	91531	41866	90814	15
46	35456	93503	37083	92870	38698	92209	40301	91519	41892	90802	14
47	35484	93493	37110	92859	38725	92198	40328	91508	41919	90790	13
48	35511	93483	37137	92849	[illegible]	[illegible]	[illegible]	[illegible]	41945	[illegible]	12

TABLE XXIV. Of Natural Sines.

	25°		26°		27°		28°		29°		
M.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	M.
0	42262	90631	43837	89879	45399	89101	46947	88295	48481	87462	60
1	42288	90618	43863	89867	45425	89087	46973	88281	48506	87448	59
2	42315	90606	43889	89854	45451	89074	46999	88267	48532	87434	58
3	42341	90594	43916	89841	45477	89061	47024	88254	48557	87420	57
4	42367	90582	43942	89828	45503	89048	47050	88240	48583	87406	56
5	42394	90569	43968	89816	45529	89035	47076	88226	48608	87391	55
6	42420	90557	43994	89803	45554	89021	47101	88213	48634	87377	54
7	42446	90545	44020	89790	45580	89008	47127	88199	48659	87363	53
8	42473	90532	44046	89777	45606	88995	47153	88185	48684	87349	52
9	42499	90520	44072	89764	45632	88981	47178	88172	48710	87335	51
10	42525	90507	44098	89752	45658	88968	47204	88158	48735	87321	50
11	42552	90495	44124	89739	45684	88955	47229	88144	48761	87306	49
12	42578	90483	44151	89726	45710	88942	47255	88130	48786	87292	48
13	42604	90470	44177	89713	45736	88928	47281	88117	48811	87278	47
14	42631	90458	44203	89700	45762	88915	47306	88103	48837	87264	46
15	42657	90446	44229	89687	45787	88902	47332	88089	48862	87250	45
16	42683	90433	44255	89674	45813	88888	47358	88075	48888	87235	44
17	42709	90421	44281	89662	45839	88875	47383	88062	48913	87221	43
18	42736	90408	44307	89649	45865	88862	47409	88048	48938	87207	42
19	42762	90396	44333	89636	45891	88848	47434	88034	48964	87193	41
20	42788	90383	44359	89623	45917	88835	47460	88020	48989	87178	40
21	42815	90371	44385	89610	45942	88822	47486	88006	49014	87164	39
22	42841	90358	44411	89597	45968	89808	47511	87993	49040	87150	38
23	42867	90346	44437	89584	45994	88795	47537	87979	49065	87136	37
24	42894	90334	44464	89571	46020	88782	47562	87965	49090	87121	36
25	42920	90321	44490	89558	46046	88768	47588	87951	49116	87107	35
26	42946	90309	44516	89545	46072	88755	47614	87937	49141	87093	34
27	42972	90296	44542	89532	46097	88741	47639	87923	49166	87079	33
28	42999	90284	44568	89519	46123	88728	47665	87909	49192	87064	32
29	43025	90271	44594	89506	46149	88715	47690	87896	49217	87050	31
30	43051	90259	44620	89493	46175	88701	47716	87882	49242	87036	30
31	43077	90246	44646	89480	46201	88688	47741	87868	49268	87021	29
32	43104	90233	44672	89467	46226	88674	47767	87854	49293	87007	28
33	43130	90221	44698	89454	46252	88661	47793	87840	49318	86993	27
34	43156	90208	44724	89441	46278	88647	47818	87826	49344	86978	26
35	43182	90196	44750	89428	46304	88634	47844	87812	49369	86964	25
36	43209	90183	44776	89415	46330	88620	47869	87798	49394	86949	24
37	43235	90171	44802	89402	46355	88607	47895	87784	49419	86935	23
38	43261	90158	44828	89389	46381	88593	47920	87770	49445	86921	22
39	43287	90146	44854	89376	46407	88580	47946	87756	49470	86906	21
40	43313	90133	44880	89363	46433	88566	47971	87743	49495	86892	20
41	43340	90120	44906	89350	46458	88553	47997	87729	49521	86878	19
42	43366	90108	44932	89337	46484	88539	48022	87715	49546	86863	18
43	43392	90095	44958	89324	46510	88526	48048	87701	49571	86849	17
44	43418	90082	44984	89311	46536	88512	48073	87687	49596	86834	16
45	43445	90070	45010	89298	46561	88499	48099	87673	49622	86820	15
46	43471	90057	45036	89285	46587	88485	48124	87659	49647	86805	14
47	43497	90045	45062	89272	46613	88472	48150	87645	49672	86791	13
48	43523	90032	45088	89259	46639	88458	48175	87631	49697	86777	12
49	43549	90019	45114	89245	46664	88445	48201	87617	49723	86762	11
50	43575	90007	45140	89232	46690	88431	48226	87603	49748	86748	10
51	43602	89994	45166	89219	46716	88417	48252	87589	49773	86733	9
52	43628	89981	45192	89206	46742	88404	48277	87575	49798	86719	8
53	43654	89968	45218	89193	46767	88390	48303	87561	49824	86704	7
54	43680	89956	45243	89180	46793	88377	48328	87546	49849	86690	6
55	43706	89943	45269	89167	46819	88363	48354	87532	49874	86675	5
56	43733	89930	45295	89153	46844	88349	48379	87518	49899	86661	4
57	43759	89918	45321	89140	46870	88336	48405	87504	49924	86646	3
58	43785	89905	45347	89127	46896	88322	48430	87490	49950	86632	2
59	43811	89892	45373	89114	46921	88308	48456	87476	49975	86617	1
60	43837	89879	45399	89101	46947	88295	48481	87462	50000	86603	0
M.	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	M.
	64°		63°		62°		61°		60°		

TABLE XXIV. Of Natural Sines.

	30°		31°		32°		33°		34°		
M.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	M.
0	50000	86603	51504	85717	52992	84805	54464	83867	55919	82904	60
1	50025	86588	51529	85702	53017	84789	54488	83851	55943	82887	59
2	50050	86573	51554	85687	53041	84774	54513	83835	55968	82871	58
3	50076	86559	51579	85672	53066	84759	54537	83819	55992	82855	57
4	50101	86544	51604	85657	53091	84743	54561	83804	56016	82839	56
5	50126	86530	51628	85642	53115	84728	54586	83788	56040	82822	55
6	50151	86515	51653	85627	53140	84712	54610	83772	56064	82806	54
7	50176	86501	51678	85612	53164	84697	54635	83756	56088	82790	53
8	50201	86486	51703	85597	53189	84681	54659	83740	56112	82773	52
9	50227	86471	51728	85582	53214	84666	54683	83724	56136	82757	51
10	50252	86457	51753	85567	53238	84650	54708	83708	56160	82741	50
11	50277	86442	51778	85551	53263	84635	54732	83692	56184	82724	49
12	50302	86427	51803	85536	53288	84619	54756	83676	56208	82708	48
13	50327	86413	51828	85521	53312	84604	54781	83660	56232	82692	47
14	50352	86398	51852	85506	53337	84588	54805	83645	56256	82675	46
15	50377	86384	51877	85491	53361	84573	54829	83629	56280	82659	45
16	50403	86369	51902	85476	53386	84557	54854	83613	56305	82643	44
17	50428	86354	51927	85461	53411	84542	54878	83597	56329	82626	43
18	50453	86340	51952	85446	53435	84526	54902	83581	56353	82610	42
19	50478	86325	51977	85431	53460	84511	54927	83565	56377	82593	41
20	50503	86310	52002	85416	53484	84495	54951	83549	56401	82577	40
21	50528	86295	52026	85401	53509	84480	54975	83533	56425	82561	39
22	50553	86281	52051	85385	53534	84464	54999	83517	56449	82544	38
23	50578	86266	52076	85370	53558	84448	55024	83501	56473	82528	37
24	50603	86251	52101	85355	53583	84433	55048	83485	56497	82511	36
25	50628	86237	52126	85340	53607	84417	55072	83469	56521	82495	35
26	50654	86222	52151	85325	53632	84402	55097	83453	56545	82478	34
27	50679	86207	52175	85310	53656	84386	55121	83437	56569	82462	33
28	50704	86192	52200	85294	53681	84370	55145	83421	56593	82446	32
29	50729	86178	52225	85279	53705	84355	55169	83405	56617	82429	31
30	50754	86163	52250	85264	53730	84339	55194	83389	56641	82413	30
31	50779	86148	52275	85249	53754	84324	55218	83373	56665	82396	29
32	50804	86133	52299	85234	53779	84308	55242	83356	56689	82380	28
33	50829	86119	52324	85218	53804	84292	55266	83340	56713	82363	27
34	50854	86104	52349	85203	53828	84277	55291	83324	56736	82347	26
35	50879	86089	52374	85188	53853	84261	55315	83308	56760	82330	25
36	50904	86074	52399	85173	53877	84245	55339	83292	56784	82314	24
37	50929	86059	52423	85157	53902	84230	55363	83276	56808	82297	23
38	50954	86045	52448	85142	53926	84214	55388	83260	56832	82281	22
39	50979	86030	52473	85127	53951	84198	55412	83244	56856	82264	21
40	51004	86015	52498	85112	53975	84182	55436	83228	56880	82248	20
41	51029	86000	52522	85096	54000	84167	55460	83212	56904	82231	19
42	51054	85985	52547	85081	54024	84151	55484	83195	56928	82214	18
43	51079	85970	52572	85066	54049	84135	55509	83179	56952	82198	17
44	51104	85956	52597	85051	54073	84120	55533	83163	56976	82181	16
45	51129	85941	52621	85035	54097	84104	55557	83147	57000	82165	15
46	51154	85926	52646	85020	54122	84088	55581	83131	57024	82148	14
47	51179	85911	52671	85005	54146	84072	55605	83115	57047	82132	13
48	51204	85896	52696	84989	54171	84057	55630	83098	57071	82115	12
49	51229	85881	52720	84974	54195	84041	55654	83082	57095	82098	11
50	51254	85866	52745	84959	54220	84025	55678	83066	57119	82082	10
51	51279	85851	52770	84943	54244	84009	55702	83050	57143	82065	9
52	51304	85836	52794	84928	54269	83994	55726	83034	57167	82048	8
53	51329	85821	52819	84913	54293	83978	55750	83017	57191	82032	7
54	51354	85806	52844	84897	54317	83962	55775	83001	57215	82015	6
55	51379	85792	52869	84882	54342	83946	55799	82985	57238	81999	5
56	51404	85777	52893	84866	54366	83930	55823	82969	57262	81982	4
57	51429	85762	52918	84851	54391	83915	55847	82953	57286	81965	3
58	51454	85747	52943	84836	54415	83899	55871	82936	57310	81949	2
59	51479	85732	52967	84820	54440	83883	55895	82920	57334	81932	1
60	51504	85717	52992	84805	54464	83867	55919	82904	57358	81915	0
M.	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	M.

TABLE XXIV. Of Natural Sines.

	35°		36°		37°		38°		39°		
M	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	M
0	57358	81915	58778	80902	60181	79864	61566	78801	62932	77715	60
1	57381	81899	58802	80885	60205	79846	61589	78783	62955	77696	59
2	57405	81882	58826	80867	60228	79829	61612	78765	62977	77678	58
3	57429	81865	58849	80850	60251	79811	61635	78747	63000	77660	57
4	57453	81848	58873	80833	60274	79793	61658	78729	63022	77641	56
5	57477	81832	58896	80816	60298	79776	61681	78711	63045	77623	55
6	57501	81815	58920	80799	60321	79758	61704	78693	63068	77605	54
7	57524	81798	58943	80782	60344	79741	61726	78676	63090	77586	53
8	57548	81781	58967	80765	60367	79723	61749	78658	63113	77568	52
9	57572	81765	58990	80748	60390	79706	61772	78640	63135	77550	51
10	57596	81748	59014	80730	60414	79688	61795	78622	63158	77531	50
11	57619	81731	59037	80713	60437	79671	61818	78604	63180	77513	49
12	57643	81714	59061	80696	60460	79653	61841	78586	63203	77494	48
13	57667	81698	59084	80679	60483	79635	61864	78568	63225	77476	47
14	57691	81681	59107	80662	60506	79618	61887	78550	63248	77458	46
15	57715	81664	59131	80644	60529	79600	61909	78532	63271	77439	45
16	57738	81647	59154	80627	60553	79583	61932	78514	63293	77421	44
17	57762	81631	59178	80610	60576	79565	61955	78496	63316	77402	43
18	57786	81614	59201	80593	60599	79547	61978	78478	63338	77384	42
19	57809	81597	59225	80576	60622	79530	62001	78460	63361	77366	41
20	57833	81580	59248	80558	60645	79512	62024	78442	63383	77347	40
21	57857	81563	59272	80541	60668	79494	62046	78424	63406	77329	39
22	57881	81546	59295	80524	60691	79477	62069	78405	63428	77310	38
23	57904	81530	59318	80507	60714	79459	62092	78387	63451	77292	37
24	57928	81513	59342	80489	60738	79441	62115	78369	63473	77273	36
25	57952	81496	59365	80472	60761	79424	62138	78351	63496	77255	35
26	57976	81479	59389	80455	60784	79406	62160	78333	63518	77236	34
27	57999	81462	59412	80438	60807	79388	62183	78315	63540	77218	33
28	58023	81445	59435	80420	60830	79371	62206	78297	63563	77199	32
29	58047	81428	59459	80403	60853	79353	62229	78279	63583	77181	31
30	58070	81412	59482	80386	60876	79335	62251	78261	63608	77162	30
31	58094	81395	59506	80368	60899	79318	62274	78243	63630	77144	29
32	58118	81378	59529	80351	60922	79300	62297	78225	63653	77125	28
33	58141	81361	59552	80334	60945	79282	62320	78206	63675	77107	27
34	58165	81344	59576	80316	60968	79264	62342	78188	63698	77088	26
35	58189	81327	59599	80299	60991	79247	62365	78170	63720	77070	25
36	58212	81310	59622	80282	61015	79229	62388	78152	63742	77051	24
37	58236	81293	59646	80264	61038	79211	62411	78134	63765	77033	23
38	58260	81276	59669	80247	61061	79193	62433	78116	63787	77014	22
39	58283	81259	59693	80230	61084	79176	62456	78098	63810	76996	21
40	58307	81242	59716	80212	61107	79158	62479	78079	63832	76977	20
41	58330	81225	59739	80195	61130	79140	62502	78061	63854	76959	19
42	58354	81208	59763	80178	61153	79122	62524	78043	63877	76940	18
43	58378	81191	59786	80160	61176	79105	62547	78025	63899	76921	17
44	58401	81174	59809	80143	61199	79087	62570	78007	63922	76903	16
45	58425	81157	59832	80125	61222	79069	62592	77988	63944	76884	15
46	58449	81140	59856	80108	61245	79051	62615	77970	63966	76866	14
47	58472	81123	59879	80091	61268	79033	62638	77952	63989	76847	13
48	58496	81106	59902	80073	61291	79015	62660	77934	64011	76828	12
49	58519	81089	59926	80056	61314	78998	62683	77916	64033	76810	11
50	58543	81072	59949	80038	61337	78980	62706	77897	64056	76791	10
51	58567	81055	59972	80021	61360	78962	62728	77879	64078	76772	9
52	58590	81038	59995	80003	61383	78944	62751	77861	64100	76754	8
53	58614	81021	60019	79986	61406	78926	62774	77843	64123	76735	7
54	58637	81004	60042	79968	61429	78908	62796	77824	64145	76717	6
55	58661	80987	60065	79951	61451	78891	62819	77806	64167	76698	5
56	58684	80970	60089	79934	61474	78873	62842	77788	64190	76679	4
57	58708	80953	60112	79916	61497	78855	62864	77769	64212	76661	3
58	58731	80936	60135	79899	61520	78837	62887	77751	64234	76642	2
59	58755	80919	60158	79881	61543	78819	62909	77733	64256	76623	1
60	58779	80902	60181	79864	61566	78801	62932	77715	64279	76604	0
M	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	M
	54°		53°		52°		51°		50°		

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	34503	93859	36135	93243	37757	92598	39367	91925	40966	91224
12	34530	93849	36162	93232	37784	92587	39394	91914	40992	91212
13	34557	93839	36190	93222	37811	92576	39421	91902	41019	91200
14	34584	93829	36217	93211	37838	92565	39448	91891	41045	91188
15	34612	93819	36244	93201	37865	92554	39474	91879	41072	91176
16	34639	93809	36271	93190	37892	92543	39501	91868	41098	91164
17	34666	93799	36298	93180	37919	92532	39528	91856	41125	91152
18	34694	93789	36325	93169	37946	92521	39555	91845	41151	91140
19	34721	93779	36352	93159	37973	92510	39581	91833	41178	91128
20	34748	93769	36379	93148	37999	92499	39608	91822	41204	91116
21	34775	93759	36406	93137	38026	92488	39635	91810	41231	91104
22	34803	93748	36434	93127	38053	92477	39661	91799	41257	91092
23	34830	93738	36461	93116	38080	92466	39688	91787	41284	91080
24	34857	93728	36488	93106	38107	92455	39715	91775	41310	91068
25	34884	93718	36515	93095	38134	92444	39741	91764	41337	91056
26	34912	93708	36542	93084	38161	92432	39768	91752	41363	91044
27	34939	93698	36569	93074	38188	92421	39795	91741	41390	91032
28	34966	93688	36596	93063	38215	92410	39822	91729	41416	91020
29	34993	93677	36623	93052	38241	92399	39848	91718	41443	91008
30	35021	93667	36650	93042	38268	92388	39875	91706	41469	90996
31	35048	93657	36677	93031	38295	92377	39902	91694	41496	90984
32	35075	93647	36704	93020	38322	92366	39928	91683	41522	90972
33	35102	93637	36731	93010	38349	92355	39955	91671	41549	90960
34	35130	93626	36758	92999	38376	92343	39982	91660	41575	90948
35	35157	93616	36785	92998	38403	92332	40008	91648	41602	90936
36	35184	93606	36812	92978	38430	92321	40035	91636	41628	90924
37	35211	93596	36839	92967	38456	92310	40062	91625	41655	90911
38	35239	93585	36867	92956	38483	92299	40088	91613	41681	90899
39	35266	93575	36894	92945	38510	92287	40115	91601	41707	90887
40	35293	93565	36921	92935	38537	92276	40141	91590	41734	90875
41	35320	93555	36948	92924	38564	92265	40168	91578	41760	90863
42	35347	93544	36975	92913	38591	92254	40195	91566	41787	90851
43	35375	93534	37002	92902	38617	92245	40221	91555	41813	90839
44	35402	93524	37029	92892	38644	92231	40248	91543	41840	90826

TABLE XXV. Proportional Logarithms.

S	h m 0° 0′	h m 0° 1′	h m 0° 2′	h m 0° 3′	h m 0° 4′	h m 0° 5′	h m 0° 6′	h m 0° 7′	h m 0° 8′
0½	4.3345	2.2553	1.9542	1.7782	1.6532	1.5563	1.4771	1.4102	1.3522
1	4.0334	2481	9506	7757	6514	5549	4759	4091	3513
2	3.7324	2410	9471	7734	6496	5534	4747	4081	3504
3	3.5563	2341	9435	7710	6478	5520	4735	4071	3495
4	3.4314	2272	9400	7686	6460	5506	4723	4061	3486
5	3.3345	2205	9365	7663	6443	5491	4711	4050	3477
6	3.2553	2139	9331	7639	6425	5477	4699	4040	3468
7	3.1883	2073	9296	7616	6407	5463	4688	4030	3459
8	3.1303	2009	9262	7593	6390	5449	4676	4020	3450
9	3.0792	1946	9228	7570	6372	5435	4664	4010	3441
10	3.0334	2.1883	1.9195	1.7547	1.6355	1.5421	1.4652	1.4000	1.3432
11	2.9920	1822	9162	7124	6338	5407	4640	3989	3423
12	9542	1761	9128	7501	6320	5393	4629	3979	3415
13	9195	1701	9096	7479	6303	5379	4617	3969	3406
14	8873	1642	9063	7456	6286	5365	4606	3959	3397
15	8573	1584	9031	7434	6269	5351	4594	3949	3388
16	8293	1526	8999	7412	6252	5337	4582	3939	3379
17	8030	1469	8967	7390	6235	5324	4571	3929	3371
18	7782	1413	8935	7368	6218	5310	4559	3919	3362
19	7547	1358	8904	7346	6201	5296	4548	3910	3353
20	2.7324	2.1303	1.8873	1.7324	1.6185	1.5283	1.4536	1.3900	1.3345
21	7112	1249	8842	7302	6168	5269	4525	3890	3336
22	6910	1196	8811	7281	6151	5256	4514	3880	3327
23	6717	1143	8781	7259	6135	5242	4502	3870	3319
24	6532	1091	8751	7238	6118	5229	4491	3860	3310
25	6355	1040	8721	7217	6102	5215	4480	3851	3301
26	6105	0989	8691	7196	6085	5202	4468	3841	3293
27	6021	0939	8661	7175	6069	5189	4457	3831	3284
28	5863	0889	8632	7154	6053	5175	4446	3821	3276
29	5710	0840	8602	7136	6037	5166	4435	3812	3267
30	2.5563	2.0792	1.8573	1.7112	1.6021	1.5149	1.4424	1.3802	1.3259
31	5421	0744	8544	7091	6005	5136	4412	3792	3250
32	5283	0696	8516	7071	5989	5123	4401	3783	3242
33	5149	0649	8487	7050	5973	5110	4390	3773	3233
34	5019	0603	8459	7030	5957	5097	4379	3764	3225
35	4894	0557	8431	7010	5941	5084	4368	3754	3216
36	4771	0512	8403	6990	5925	5071	4357	3745	3208
37	4652	0467	8375	6970	5909	5058	4346	3735	3199
38	4536	0422	8348	6950	5894	5045	4335	3726	3191
39	4424	0378	8320	6930	5878	5032	4325	3716	3183
40	2.4314	2.0334	1.8293	1.6910	1.5863	1.5019	1.4314	1.3707	1.3174
41	4206	0291	8266	6890	5847	5007	4303	3697	5166
42	4102	0248	8239	6871	5832	4994	4292	3688	3158
43	4000	0206	8212	6851	5816	4981	4281	3678	3149
44	3900	0164	8186	6832	5801	4969	4270	3669	3141
45	3802	0122	8159	6812	5786	4956	4260	3660	3133
46	3707	0081	8133	6793	5771	4943	4249	3650	3124
47	3613	0040	8107	6774	5755	4931	4238	3641	3116
48	3522	0000	8081	6755	5740	4918	4228	3632	3108
49	3432	1.9960	8055	6736	5725	4906	4217	3623	3100
50	2.3345	1.9920	1.8030	1.6717	1.5710	1.4894	1.4206	1.3613	1.3091
51	3259	9881	8004	5698	5695	4881	4196	3604	3083
52	3174	9842	7979	6679	5680	4869	4185	3595	3075
53	3091	9803	7954	6661	5666	4856	4175	3586	3067
54	3010	9765	7929	6642	5651	4844	4164	3576	3059
55	2931	9727	7904	6624	5636	4832	4154	3567	3051
56	2852	9690	7879	6605	5621	4820	4143	3558	3043
57	2775	9652	7855	6587	5607	4808	4133	3549	3034
58	2700	9615	7830	6568	5592	4795	4122	3540	3026
59	2626	9579	7806	6550	5578	4783	4112	3531	3018
60	2.2553	1.9542	1.7782	1.6532	1.5563	1.4771	1.4102	1.3522	1.3010
S	h m 0° 0′	h m 0° 1′	h m 0° 2′	h m 0° 3′	h m 0° 4′	h m 0° 5′	h m 0° 6′	h m 0° 7′	h m 0° 8′

11	2923	2474	2067	1695	[illegible]	[illegible]
12	2915	2467	2061	1689	1347	1030
13	2907	2460	2054	1683	1342	1025
14	2899	2453	2048	1677	1336	1020
15	2891	2445	2041	1671	1331	1015
16	2883	2438	2035	1665	1325	1009
17	2876	2431	2028	1660	1320	1004
18	2868	2424	2022	1654	1314	0999
19	2860	2417	2016	1648	1309	0994
20	1.2852	1.2410	1.2009	1.1642	1.1303	1.0989
21	2845	2403	2003	1636	1298	0984
22	2837	2396	1996	1630	1292	0979
23	2829	2389	1990	1624	1287	0974
24	2821	2382	1984	1619	1282	0969
25	2814	2375	1977	1613	1276	0964
26	2806	2368	1971	1607	1271	0959
27	2798	2362	1965	1601	1266	0954
28	2791	2355	1958	1595	1260	0949
29	2783	2348	1952	1589	1255	0944
30	1.2775	1.2341	1.1946	1.1584	1.1249	1.0939
31	2768	2334	1939	1578	1244	0934
32	2760	2327	1933	1572	1239	0929
33	2753	2320	1927	1566	1233	0924
34	2745	2313	1921	1561	1228	9919
35	2738	2307	1914	1555	1223	0914
36	2750	2300	1908	1549	1217	0909
37	2722	2293	1902	1543	1212	0904
38	2715	2286	1896	1538	1297	0899
39	2707	2279	1889	1532	1201	0894
40	1.2700	1.2272	1.1883	1.1526	1.1196	1.0889
41	2692	2266	1877	1520	1191	0884
42	2685	2259	1871	1515	1186	0880
43	2678	2252	1865	1509	1180	0875
44	2670	2245	1858	1503	1175	0870
45	2663	2239	1852	1498	1170	0865
46	2655	2232	1846	1492	1164	0860
47	2648	2225	1840	1486	1159	0855
48	2640	2218	1834	1481	1154	0850
[illegible]	[illegible]	[illegible]	1828	1475	1149	0845

S	h m 0° 18′	h m 0° 19′	h m 0° 20′	h m 0° 21′	h m 0° 22′	h m 0° 23′	h m 0° 24′	h m 0° 25′	h m 0° 26′	h m 0° 27′	h m 0° 28′	h m 0° 29′
0	10000	9765	9542	9331	9128	8935	8751	8573	8403	8239	8081	7929
1	9996	9761	9539	9327	9125	8932	8748	8570	8400	8236	8079	7926
2	9992	9758	9535	9324	9122	8929	8745	8568	8397	8234	8076	7924
3	9988	9754	9532	9320	9119	8926	8742	8565	8395	8231	8073	7921
4	9984	9750	9528	9317	9115	8923	8739	8562	8392	8228	8071	7919
5	9980	9746	9524	9313	9112	8920	8736	8559	8389	8226	8068	7916
6	9976	9742	9521	9310	9109	8917	8733	8556	8386	8223	8056	7914
7	9972	9739	9517	9306	9106	8913	8730	8553	8384	8220	8063	7911
8	9968	9735	9514	9303	9102	8910	8727	8550	8381	8218	8061	7909
9	9964	9731	9510	9300	9099	8907	8724	8547	8378	8215	8058	7906
10	9960	9727	9506	9296	9096	8904	8721	8544	8375	8212	8055	7904
11	9956	9723	9503	9293	9092	8901	8718	8542	8372	8210	8053	7901
12	9952	9720	9499	9289	9089	8898	8715	8539	8370	8207	8050	7899
13	9948	9716	9496	9286	9086	8895	8712	8536	8367	8204	8048	7896
14	9944	9712	9492	9283	9083	8892	8709	8533	8364	8202	8045	7894
15	9940	9708	9488	9279	9079	8888	8706	8530	8361	8199	8043	7891
16	9936	9705	9485	9276	9076	8885	8703	8527	8359	8196	8040	7889
17	9932	9701	9481	9272	9073	8882	8700	8524	8356	8194	8037	7887
18	9928	9697	9478	9269	9070	8879	8697	8522	8353	8191	8035	7884
19	9924	9693	9474	9266	9066	8876	8694	8519	8350	8188	8032	7882
20	9920	9690	9471	9262	9063	8873	8691	8516	8348	8186	8030	7879
21	9916	9686	9467	9259	9060	8870	8688	8513	8345	8183	8027	7877
22	9912	9682	9464	9255	9057	8867	8685	8510	8342	8181	8025	7874
23	9908	9678	9460	9252	9053	8864	8682	8507	8339	8178	8022	7872
24	9905	9675	9456	9249	9050	8861	8679	8504	8337	8175	8020	7869
25	9901	9671	9453	9245	9047	8857	8676	8502	8334	8173	8017	7867
26	9897	9667	9449	9242	9044	8854	8673	8499	8331	8170	8014	7864
27	9893	9664	9446	9238	9041	8851	8670	8496	8328	8167	8012	7862
28	9889	9660	9442	9235	9037	8848	8667	8493	8326	8165	8009	7859
29	9885	9656	9439	9232	9034	8845	8664	8490	8323	8162	8007	7857
30	9881	9652	9435	9228	9031	8842	8661	8487	8320	8159	8004	7855
31	9877	9649	9431	9225	9028	8839	8658	8484	8318	8157	8002	7852
32	9873	9645	9428	9222	9024	8836	8655	8482	8315	8154	7999	7850
33	9869	9641	9425	9218	9021	8833	8652	8479	8312	8152	7997	7847
34	9865	9638	9421	9215	9018	8830	8649	8476	8309	8149	7994	7845
35	9861	9634	9418	9212	9015	8827	8646	8473	8307	8146	7992	7842
36	9858	9630	9414	9208	9012	8824	8643	8470	8304	8144	7989	7840
37	9854	9626	9411	9205	9008	8821	8640	8467	8301	8141	7987	7837
38	9850	9623	9407	9201	9005	8817	8637	8465	8298	8138	7984	7835
39	9846	9619	9404	9198	9002	8814	8635	8462	8296	8136	7981	7832
40	9842	9615	9400	9195	8999	8811	8632	8459	8293	8133	7979	7830
41	9838	9612	9397	9191	8996	8808	8629	8456	8290	8131	7976	7828
42	9834	9608	9393	9188	8992	8805	8626	8453	8288	8128	7974	7825
43	9830	9604	9390	9185	8989	8802	8623	8451	8285	8125	7971	7823
44	9827	9601	9386	9181	8986	8799	8620	8448	8282	8123	7969	7820
45	9823	9597	9383	9178	8983	8796	8617	8445	8279	8120	7966	7818
46	9819	9593	9379	9175	8980	8793	8614	8442	8277	8117	7964	7815
47	9815	9590	9376	9172	8977	8790	8611	8439	8274	8115	7961	7813
48	9811	9586	9372	9168	8973	8787	8608	8437	8271	8112	7959	7811
49	9807	9582	9369	9165	8970	8784	8605	8434	8269	8110	7956	7808
50	9803	9579	9365	9162	8967	8781	8602	8431	8266	8107	7954	7806
51	9800	9575	9362	9158	8964	8778	8599	8428	8263	8104	7951	7803
52	9796	9571	9358	9155	8961	8775	8597	8425	8261	8102	7949	7801
53	9792	9568	9355	9152	8958	8772	8594	8423	8258	8099	7946	7798
54	9788	9564	9351	9148	8954	8769	8591	8420	8255	8097	7944	7796
55	9784	9561	9348	9145	8951	8766	8588	8417	8253	8094	7941	7794
56	9780	9557	9344	9142	8948	8763	8585	8414	8250	8091	7939	7791
57	9777	9553	9341	9138	8945	8760	8582	8411	8247	8089	7936	7789
58	9773	9550	9337	9135	8942	8757	8579	8409	8244	8086	7934	7786
59	9769	9546	9334	9132	8939	8754	8576	8406	8242	8084	7931	7784
60	9765	9542	9331	9128	8935	8751	8573	8403	8239	8081	7929	7782
S	h m 0° 18′	h m 0° 19′	h m 0° 20′	h m 0° 21′	h m 0° 22′	h m 0° 23′	h m 0° 24′	h m 0° 25′	h m 0° 26′	h m 0° 27′	h m 0° 28′	h m 0° 29′

S	h m 0° 30′	h m 0° 31′	h m 0° 32′	h m 0° 33′	h m 0° 34′	h m 0° 35′	h m 0° 36′	h m 0° 37′	h m 0° 38′	h m 0° 39′	h m 0° 40′	h m 0° 41′
0	7782	7639	7501	7368	7238	7112	6990	6871	6755	6642	6532	6425
1	7779	7637	7499	7365	7236	7110	6988	6869	6753	6640	6530	6423
2	7777	7634	7497	7363	7234	7108	6986	6867	6751	6638	6529	6421
3	7774	7632	7494	7361	7232	7106	6984	6865	6749	6637	6527	6420
4	7772	7630	7492	7359	7229	7104	6982	6863	6747	6635	6525	6418
5	7769	7627	7490	7357	7227	7102	6980	6861	6745	6633	6523	6416
6	7767	7625	7488	7354	7225	7100	6978	6859	6743	6631	6521	6414
7	7765	7623	7485	7352	7223	7098	6976	6857	6742	6629	6519	6413
8	7762	7620	7483	7350	7221	7096	6974	6855	6740	6627	6518	6411
9	7760	7618	7481	7348	7219	7093	6972	6853	6738	6625	6516	6409
10	7757	7616	7479	7346	7217	7091	6970	6851	6736	6624	6514	6407
11	7755	7613	7476	7344	7215	7089	6968	6849	6734	6622	6512	6406
12	7753	7611	7474	7341	7212	7087	6966	6847	6732	6620	6510	6404
13	7750	7609	7472	7339	7210	7085	6964	6845	6730	6618	6509	6402
14	7748	7607	7470	7337	7208	7083	6962	6843	6728	6616	6507	6400
15	7745	7604	7467	7335	7206	7081	6960	6841	6726	6614	6505	6398
16	7743	7602	7465	7333	7204	7079	6958	6840	6725	6612	6503	6397
17	7741	7600	7463	7330	7202	7077	6956	6838	6723	6611	6501	6395
18	7738	7597	7461	7328	7200	7075	6954	6836	6721	6609	6500	6393
19	7736	7595	7458	7326	7198	7073	6952	6834	6719	6607	6498	6391
20	7734	7593	7456	7324	7196	7071	6950	6832	6717	6605	6496	6390
21	7731	7590	7454	7322	7193	7069	6948	6830	6715	6603	6494	6388
22	7729	7588	7452	7320	7191	7067	6946	6828	6713	6601	6492	6386
23	7726	7586	7450	7317	7189	7065	6944	6826	6711	6600	6491	6384
24	7724	7583	7447	7315	7187	7063	6942	6824	6709	6598	6489	6383
25	7722	7581	7445	7313	7185	7061	6940	6822	6708	6596	6487	6381
26	7719	7579	7443	7311	7183	7059	6938	6820	6706	6594	6485	6379
27	7717	7577	7441	7309	7181	7057	6936	6818	6704	6592	6484	6377
28	7714	7574	7438	7307	7179	7055	6934	6816	6702	6590	6482	6376
29	7712	7572	7436	7304	7177	7052	6932	6814	6700	6589	6480	6374
30	7710	7570	7434	7302	7175	7050	6930	6812	6698	6587	6478	6372
31	7707	7567	7432	7300	7172	7048	6928	6810	6696	6585	6476	6371
32	7705	7565	7429	7298	7170	7046	6926	6809	6694	6583	6475	6369
33	7703	7563	7427	7296	7168	7044	6924	6807	6692	6581	6473	6367
34	7700	7560	7425	7294	7166	7042	6922	6805	6691	6579	6471	6365
35	7698	7558	7423	7291	7164	7040	6920	6803	6689	6578	6469	6364
36	7696	7556	7421	7289	7162	7038	6918	6801	6687	6576	6467	6362
37	7693	7554	7418	7287	7160	7036	6916	6799	6685	6574	6466	6360
38	7691	7551	7416	7285	7158	7034	6914	6797	6683	6572	6464	6358
39	7688	7549	7414	7283	7156	7032	6912	6795	6681	6570	6462	6357
40	7686	7547	7412	7281	7154	7030	6910	6793	6679	6568	6460	6355
41	7684	7544	7409	7279	7152	7028	6908	6791	6677	6567	6459	6353
42	7681	7542	7407	7276	7149	7026	6906	6789	6676	6565	6457	6351
43	7679	7540	7405	7274	7147	7024	6904	6787	6674	6563	6455	6350
44	7677	7538	7403	7272	7145	7022	6902	6785	6672	6561	6453	6348
45	7674	7535	7401	7270	7143	7020	6900	6784	6670	6559	6451	6346
46	7672	7533	7398	7268	7141	7018	6898	6782	6668	6558	6450	6344
47	7670	7531	7396	7266	7139	7016	6896	6780	6666	6556	6448	6343
48	7667	7528	7394	7264	7137	7014	6894	6778	6664	6554	6446	6341
49	7665	7526	7392	7261	7135	7012	6892	6776	6663	6552	6444	6339
50	7663	7524	7390	7259	7133	7010	6890	6774	6661	6550	6443	6338
51	7660	7522	7387	7257	7131	7008	6888	6772	6659	6548	6441	6336
52	7658	7519	7385	7255	7129	7006	6886	6770	6657	6547	6439	6334
53	7655	7517	7383	7253	7127	7004	6884	6768	6655	6545	6437	6332
54	7653	7515	7381	7251	7124	7002	6882	6766	6653	6543	6435	6331
55	7651	7513	7379	7249	7122	7000	6881	6764	6651	6541	6434	6329
56	7648	7510	7376	7246	7120	6998	6879	6763	6650	6539	6432	6327
57	7646	7508	7374	7244	7118	6996	6877	6761	6648	6538	6430	6325
58	7644	7506	7372	7242	7116	6994	6875	6759	6646	6536	6428	6324
59	7641	7503	7370	7240	7114	6992	6873	6757	6644	6534	6427	6322
60	7639	7501	7368	7238	7112	6990	6871	6755	6642	6532	6425	6320
S	h m 0° 30′	h m 0° 31′	h m 0° 32′	h m 0° 33′	h m 0° 34′	h m 0° 35′	h m 0° 36′	h m 0° 37′	h m 0° 38′	h m 0° 39′	h m 0° 40′	h m 0° 41′

S	h m 0°42′	h m 0°43′	h m 0°44′	h m 0°45′	h m 0°46′	h m 0°47′	h m 0°48′	h m 0°49′	h m 0°50′	h m 0°51′	h m 0°52′	h m 0°53′
0	6320	6218	6118	6021	5925	5832	5740	5651	5563	5477	5393	5310
1	6319	6216	6117	6019	5924	5830	5739	5649	5562	5476	5391	5309
2	6317	6215	6115	6017	5922	5829	5737	5648	5560	5474	5390	5307
3	6315	6213	6113	6016	5920	5827	5736	5646	5559	5473	5389	5306
4	6313	6211	6112	6014	5919	5826	5734	5645	5557	5471	5387	5305
5	6312	6210	6110	6013	5917	5824	5733	5643	5556	5470	5386	5303
6	6310	6208	6108	6011	5916	5823	5731	5642	5554	5469	5384	5302
7	6308	6206	6107	6009	5914	5821	5730	5640	5553	5467	5383	5300
8	6306	6205	6105	6008	5913	5819	5728	5639	5551	5466	5382	5299
9	6305	6203	6103	6006	5911	5818	5727	5637	5550	5464	5380	5298
10	6303	6201	6102	6005	5909	5816	5725	5636	5549	5463	5379	5296
11	6301	6200	6100	6003	5908	5815	5724	5635	5547	5461	5377	5295
12	6300	6198	6099	6001	5906	5813	5722	5633	5546	5460	5376	5294
13	6298	6196	6097	6000	5905	5812	5721	5632	5544	5459	5375	5292
14	6296	6195	6095	5998	5903	5810	5719	5630	5543	5457	5373	5291
15	6294	6193	6094	5997	5902	5809	5718	5629	5541	5456	5372	5290
16	6293	6191	6092	5995	5900	5807	5716	5627	5540	5454	5370	5288
17	6291	6190	6090	5993	5898	5806	5715	5626	5538	5453	5369	5287
18	6289	6188	6089	5992	5897	5804	5713	5624	5537	5452	5368	5285
19	6288	6186	6087	5990	5895	5803	5712	5623	5536	5450	5366	5284
20	6286	6185	6085	5989	5894	5801	5710	5621	5534	5449	5365	5283
21	6284	6183	6084	5987	5892	5800	5709	5620	5533	5447	5364	5281
22	6282	6181	6082	5985	5891	5798	5707	5618	5531	5446	5362	5280
23	6281	6179	6081	5984	5889	5796	5706	5617	5530	5445	5361	5279
24	6279	6178	6079	5982	5888	5795	5704	5615	5528	5443	5359	5277
25	6277	6176	6077	5981	5886	5793	5703	5614	5527	5442	5358	5276
26	6276	6174	6076	5979	5884	5792	5701	5613	5526	5440	5357	5275
27	6274	6173	6074	5977	5883	5790	5700	5611	5524	5439	5355	5273
28	6272	6171	6072	5976	5881	5789	5698	5610	5523	5437	5354	5272
29	6271	6169	6071	5974	5880	5787	5697	5608	5521	5436	5353	5271
30	6269	6168	6069	5973	5878	5786	5695	5607	5520	5435	5351	5269
31	6267	6166	6067	5971	5877	5784	5694	5605	5518	5433	5350	5268
32	6265	6165	6066	5969	5875	5783	5692	5604	5517	5432	5348	5266
33	6264	6163	6064	5968	5874	5781	5691	5602	5516	5430	5347	5265
34	6262	6161	6063	5966	5872	5780	5689	5601	5514	5429	5346	5264
35	6260	6160	6061	5965	5870	5778	5688	5599	5513	5428	5344	5262
36	6259	6158	6059	5963	5869	5777	5686	5598	5511	5426	5343	5261
37	6257	6156	6058	5961	5867	5775	5685	5596	5510	5425	5341	5260
38	6255	6155	6056	5960	5866	5774	5683	5595	5508	5423	5340	5258
39	6254	6153	6055	5958	5864	5772	5682	5594	5507	5422	5339	5257
40	6252	6151	6053	5957	5863	5771	5680	5592	5506	5421	5337	5256
41	6250	6150	6051	5955	5861	5769	5679	5591	5504	5419	5336	5254
42	6248	6148	6050	5954	5860	5768	5677	5589	5503	5418	5335	5253
43	6247	6146	6048	5952	5858	5766	5676	5588	5501	5416	5333	5252
44	6245	6145	6046	5950	5856	5765	5674	5586	5500	5415	5332	5250
45	6243	6143	6045	5949	5855	5763	5673	5585	5498	5414	5331	5249
46	6242	6141	6043	5947	5853	5761	5671	5583	5497	5412	5329	5248
47	6240	6140	6042	5946	5852	5760	5670	5582	5496	5411	5328	5246
48	6238	6138	6040	5944	5850	5758	5669	5580	5494	5409	5326	5245
49	6237	6136	6038	5942	5849	5757	5667	5579	5493	5408	5325	5244
50	6235	6135	6037	5941	5847	5755	5666	5578	5491	5407	5324	5242
51	6233	6133	6035	5939	5846	5754	5664	5576	5490	5405	5322	5241
52	6232	6131	6033	5938	5844	5752	5663	5575	5488	5404	5321	5240
53	6230	6130	6032	5936	5843	5751	5661	5573	5487	5402	5320	5238
54	6228	6128	6030	5935	5841	5749	5660	5572	5486	5401	5318	5237
55	6226	6126	6029	5933	5839	5748	5658	5570	5484	5400	5317	5235
56	6225	6125	6027	5931	5838	5746	5657	5569	5483	5398	5315	5234
57	6223	6123	6025	5930	5836	5745	5655	5567	5481	5397	5314	5233
58	6221	6121	6024	5928	5835	5743	5654	5566	5480	5395	5313	5231
59	6220	6120	6022	5927	5833	5742	5652	5564	5478	5394	5311	5230
60	6218	6118	6021	5925	5832	5740	5651	5563	5477	5393	5310	5229
S	h m 0°42′	h m 0°43′	h m 0°44′	h m 0°45′	h m 0°46′	h m 0°47′	h m 0°48′	h m 0°49′	h m 0°50′	h m 0°51′	h m 0°52′	h m 0°53′

11	5214	5135	5057	4980	4905	4831	4758	4686	461
12	5213	5133	5055	4979	4903	4830	4757	4685	461
13	5211	5132	5054	4977	4902	4828	4756	4684	461
14	5210	5131	5053	4976	4901	4827	4754	4683	461
15	5209	5129	5051	4975	4900	4826	4753	4682	461
16	5207	5128	5050	4974	4899	4825	4752	4680	461
17	5206	5127	5049	4972	4897	4823	4751	4679	460
18	5205	5125	5048	4971	4896	4822	4750	4678	460
19	5203	5124	5046	4970	4895	4821	4748	4677	460
20	5202	5123	5045	4969	4894	4820	4747	4676	460
21	5201	5122	5044	4967	4892	4819	4746	4675	460
22	5199	5120	5043	4966	4891	4817	4745	4673	460
23	5198	5119	5041	4965	4890	4816	4744	4672	460
24	5197	5118	5040	4964	4889	4815	4742	4671	460
25	5195	5116	5039	4962	4887	4814	4741	4670	460
26	5194	5115	5037	4961	4886	4812	4740	4669	459
27	5193	5114	5036	4960	4885	4811	4739	4668	459
28	5191	5112	5035	4959	4884	4810	4738	4666	459
29	5190	5111	5034	4957	4882	4809	4736	4665	459
30	5189	5110	5032	4956	4881	4908	4735	4664	459
31	5187	5108	5031	4955	4880	4806	4734	4663	459
32	5186	5107	5030	4954	4879	4805	4733	4662	459
33	5185	5106	5028	4952	4877	4804	4732	4660	459
34	5183	5105	5027	4951	4876	4803	4730	4659	458
35	5182	5103	5026	4950	4875	4801	4729	4658	458
36	5181	5102	5025	4949	4874	4800	4728	4657	458
37	5179	5101	5023	4947	4873	4799	4727	4656	458
38	5178	5099	5022	4946	4871	4798	4726	4655	458
39	5177	5098	5021	4945	4870	4797	4724	4653	458
40	5175	5097	5019	4943	4869	4795	4723	4652	458
41	5174	5095	5018	4942	4868	4794	4722	4651	458
42	5173	5094	5017	4941	4866	4793	4721	4650	458
43	5172	5093	5016	4940	4865	4792	4720	4649	457
44	5170	5092	5014	4938	4864	4791	4718	4648	457
45	5169	5090	5013	4937	4863	4789	4717	4646	457
46	5168	5089	5012	4936	4861	4788	4716	4645	457
47	5166	5088	5011	4935	4860	4787	4715	4644	457
48	5165	5086	5009	4933	4859	4786	4714	4643	457
49	5164	5085	5008	4932	4858	4784	4712	4642	457

S	h m 1° 6′	h m 1° 7′	h m 1° 8′	h m 1° 9′	h m 1° 10′	h m 1° 11′	h m 1° 12′	h m 1° 13′	h m 1° 14′	h m 1° 15′	h m 1° 16′	h m 1° 17′
0	4357	4292	4228	4164	4102	4040	3979	3919	3060	3802	3745	3688
1	4356	4291	4227	4163	4101	4039	3978	3919	3859	3801	3744	3687
2	4355	4290	4226	4162	4100	4038	3977	3918	3858	3800	3743	3686
3	4354	4289	4224	4161	4099	4037	3976	3917	3857	3799	3742	3685
4	4353	4288	4223	4160	4098	4036	3975	3916	3856	3798	3741	3684
5	4352	4287	4222	4159	4097	4035	3974	3915	3856	3797	3740	3683
6	4351	4285	4221	4158	4096	4034	3973	3914	3855	3796	3739	3682
7	4350	4284	4220	4157	4095	4033	3972	3913	3854	3795	3738	3681
8	4349	4283	4219	4156	4093	4032	3971	3912	3853	3794	3737	3680
9	4347	4282	4218	4155	4092	4031	3970	3911	3852	3793	3736	3679
10	4346	4281	4217	4154	4091	4030	3969	3910	3851	3792	3735	3678
11	4345	4280	4216	4153	4090	4029	3968	3909	3850	3792	3734	3677
12	4344	4279	4215	4152	4089	4028	3967	3908	3849	3791	3733	3677
13	4343	4278	4214	4151	4088	4027	3966	3907	3848	3790	3732	3676
14	4342	4277	4213	4150	4087	4026	3965	3906	3847	3789	3731	3675
15	4341	4276	4212	4149	4086	4025	3964	3905	3846	3788	3730	3674
16	4340	4275	4211	4147	4085	4024	3963	3904	3845	3787	3729	3673
17	4339	4274	4210	4146	4084	4023	3962	3903	3844	3786	3728	3672
18	4338	4273	4209	4145	4083	4022	3961	3902	3843	3785	3727	3671
19	4336	4271	4207	4144	4082	4021	3960	3901	3842	3784	3727	3670
20	4335	4270	4206	4143	4081	4020	3959	3900	3841	3783	3726	3669
21	4334	4269	4205	4142	4080	4019	3958	3899	3840	3782	3725	3668
22	4333	4268	4204	4141	4079	4018	3957	3898	3839	3781	3724	3667
23	4332	4267	4203	4140	4078	4017	3956	3897	3838	3780	3723	3666
24	4331	4266	4202	4139	4077	4016	3955	3896	3837	3779	3722	3665
25	4330	4265	4201	4138	4076	4015	3954	3895	3836	3778	3721	3664
26	4329	4264	4200	4137	4075	4014	3953	3894	3835	3777	3720	3663
27	4328	4263	4199	4136	4074	4013	3952	3893	3834	3776	3719	3663
28	4327	4262	4198	4135	4073	4012	3951	3892	3833	3775	3718	3662
29	4326	4261	4197	4134	4072	4011	3950	3891	3832	3774	3717	3661
30	4325	4260	4196	4133	4071	4010	3949	3890	3831	3773	3716	3660
31	4323	4259	4195	4132	4070	4009	3948	3889	3830	3772	3715	3659
32	4322	4258	4194	4131	4069	4008	3947	3888	3829	3771	3714	3658
33	4321	4256	4193	4130	4068	4007	3946	3887	3828	3770	3713	3657
34	4320	4255	4192	4129	4067	4006	3945	3886	3827	3769	3712	3656
35	4319	4254	4191	4128	4066	4005	3944	3885	3826	3768	3711	3655
36	4318	4253	4189	4127	4065	4004	3943	3884	3825	3768	3710	3654
37	4317	4252	4188	4126	4064	4003	3942	3883	3824	3767	3709	3653
38	4316	4251	4187	4125	4063	4002	3941	3882	3823	3766	3709	3652
39	4315	4250	4186	4124	4062	4001	3940	3881	3822	3765	3708	3651
40	4314	4249	4185	4122	4061	4000	3939	3880	3821	3764	3707	3650
41	4313	4248	4184	4121	4060	3999	3938	3879	3820	3763	3706	3649
42	4311	4247	4183	4120	4059	3998	3937	3878	3820	3762	3705	3649
43	4310	4246	4182	4119	4058	3997	3936	3877	3819	3761	3704	3648
44	4309	4245	4181	4118	4056	3996	3935	3876	3818	3760	3703	3647
45	4308	4244	4180	4117	4055	3995	3934	3875	3817	3759	3702	3646
46	4307	4243	4179	4116	4054	3993	3933	3874	3816	3758	3701	3645
47	4306	4241	4178	4115	4053	3992	3932	3873	3815	3757	3700	3644
48	4305	4240	4177	4114	4052	3991	3931	3872	3814	3756	3699	3643
49	4304	4239	4176	4113	4051	3990	3930	3871	3813	3755	3698	3642
50	4303	4238	4175	4112	4050	3989	3929	3870	3812	3754	3697	3641
51	4302	4237	4174	4111	4049	3988	3928	3869	3811	3753	3696	3640
52	4301	4236	4173	4110	4048	3987	3927	3868	3810	3752	3695	3639
53	4300	4235	4172	4109	4047	3986	3926	3867	3809	3751	3694	3638
54	4298	4234	4171	4108	4046	3985	3925	3866	3808	3750	3693	3637
55	4297	4233	4169	4107	4045	3984	3924	3865	3807	3749	3693	3636
56	4296	4232	4168	4106	4044	3983	3923	3864	3806	3748	3692	3635
57	4295	4231	4167	4105	4043	3982	3922	3863	3805	3747	3691	3635
58	4294	4230	4166	4104	4042	3981	3921	3862	3804	3746	3690	3634
59	4293	4229	4165	4103	4041	3980	3920	3861	3803	3746	3689	3633
60	4292	4228	4164	4102	4040	3979	3919	3860	3802	3745	3688	3632
S	h m 1° 6′	h m 1° 7′	h m 1° 8′	h m 1° 9′	h m 1° 10′	h m 1° 11′	h m 1° 12′	h m 1° 13′	h m 1° 14′	h m 1° 15′	h m 1° 16′	h m 1° 17′

S	h m 0° 30′	h m 0° 31′	h m 0° 32′	h m 0° 33′	h m 0° 34′	h m 0° 35′	h m 0° 36′	h m 0° 37′	h m 0° 38′	h m 0° 39′	h m 0° 40′	h m 0° 41′
0	7782	7639	7501	7368	7238	7112	6990	6871	6755	6642	6532	6425
1	7779	7637	7499	7365	7236	7110	6988	6869	6753	6640	6530	6423
2	7777	7634	7497	7363	7234	7108	6986	6867	6751	6638	6529	6421
3	7774	7632	7494	7361	7232	7106	6984	6865	6749	6637	6527	6420
4	7772	7630	7492	7359	7229	7104	6982	6863	6747	6635	6525	6418
5	7769	7627	7490	7357	7227	7102	6980	6861	6745	6633	6523	6416
6	7767	7625	7488	7354	7225	7100	6978	6859	6743	6631	6521	6414
7	7765	7623	7485	7352	7223	7098	6976	6857	6742	6629	6519	6413
8	7762	7620	7483	7350	7221	7096	6974	6855	6740	6627	6518	6411
9	7760	7618	7481	7348	7219	7093	6972	6853	6738	6625	6516	6409
10	7757	7616	7479	7346	7217	7091	6970	6851	6736	6624	6514	6407
11	7755	7613	7476	7344	7215	7089	6968	6849	6734	6622	6512	6406
12	7753	7611	7474	7341	7212	7087	6966	6847	6732	6620	6510	6404
13	7750	7609	7472	7339	7210	7085	6964	6845	6730	6618	6509	6402
14	7748	7607	7470	7337	7208	7083	6962	6843	6728	6616	6507	6400
15	7745	7604	7467	7335	7206	7081	6960	6841	6726	6614	6505	6398
16	7743	7602	7465	7333	7204	7079	6958	6840	6725	6612	6503	6397
17	7741	7600	7463	7330	7202	7077	6956	6838	6723	6611	6501	6395
18	7738	7597	7461	7328	7200	7075	6954	6836	6721	6609	6500	6393
19	7736	7595	7458	7326	7198	7073	6952	6834	6719	6607	6498	6391
20	7734	7593	7456	7324	7196	7071	6950	6832	6717	6605	6496	6390
21	7731	7590	7454	7322	7193	7069	6948	6830	6715	6603	6494	6388
22	7729	7588	7452	7320	7191	7067	6946	6828	6713	6601	6492	6386
23	7726	7586	7450	7317	7189	7065	6944	6826	6711	6600	6491	6384
24	7724	7583	7447	7315	7187	7063	6942	6824	6709	6598	6489	6383
25	7722	7581	7445	7313	7185	7061	6940	6822	6708	6596	6487	6381
26	7719	7579	7443	7311	7183	7059	6938	6820	6706	6594	6485	6379
27	7717	7577	7441	7309	7181	7057	6936	6818	6704	6592	6484	6377
28	7714	7574	7438	7307	7179	7055	6934	6816	6702	6590	6482	6376
29	7712	7572	7436	7304	7177	7052	6932	6814	6700	6589	6480	6374
30	7710	7570	7434	7302	7175	7050	6930	6812	6698	6587	6478	6372
31	7707	7567	7432	7300	7172	7048	6928	6810	6696	6585	6476	6371
32	7705	7565	7429	7298	7170	7046	6926	6809	6694	6583	6475	6369
33	7703	7563	7427	7296	7168	7044	6924	6807	6692	6581	6473	6367
34	7700	7560	7425	7294	7166	7042	6922	6805	6691	6579	6471	6365
35	7698	7558	7423	7291	7164	7040	6920	6803	6689	6578	6469	6364
36	7696	7556	7421	7289	7162	7038	6918	6801	6687	6576	6467	6362
37	7693	7554	7418	7287	7160	7036	6916	6799	6685	6574	6466	6360
38	7691	7551	7416	7285	7158	7034	6914	6797	6683	6572	6464	6358
39	7688	7549	7414	7283	7156	7032	6912	6795	6681	6570	6462	6357
40	7686	7547	7412	7281	7154	7030	6910	6793	6679	6568	6460	6355
41	7684	7544	7409	7279	7152	7028	6908	6791	6677	6567	6459	6353
42	7681	7542	7407	7276	7149	7026	6906	6789	6676	6565	6457	6351
43	7679	7540	7405	7274	7147	7024	6904	6787	6674	6563	6455	6350
44	7677	7538	7403	7272	7145	7022	6902	6785	6672	6561	6453	6348
45	7674	7535	7401	7270	7143	7020	6900	6784	6670	6559	6451	6346
46	7672	7533	7398	7268	7141	7018	6898	6782	6668	6558	6450	6344
47	7670	7531	7396	7266	7139	7016	6896	6780	6666	6556	6448	6343
48	7667	7528	7394	7264	7137	7014	6894	6778	6664	6554	6446	6341
49	7665	7526	7392	7261	7135	7012	6892	6776	6663	6552	6444	6339
50	7663	7524	7390	7259	7133	7010	6890	6774	6661	6550	6443	6338
51	7660	7522	7387	7257	7131	7008	6888	6772	6659	6548	6441	6336
52	7658	7519	7385	7255	7129	7006	6886	6770	6657	6547	6439	6334
53	7655	7517	7383	7253	7127	7004	6884	6768	6655	6545	6437	6332
54	7653	7515	7381	7251	7124	7002	6882	6766	6653	6543	6435	6331
55	7651	7513	7379	7249	7122	7000	6881	6764	6651	6541	6434	6329
56	7648	7510	7376	7246	7120	6998	6879	6763	6650	6539	6432	6327
57	7646	7508	7374	7244	7118	6996	6877	6761	6648	6538	6430	6325
58	7644	7506	7372	7242	7116	6994	6875	6759	6646	6536	6428	6324
59	7641	7503	7370	7240	7114	6992	6873	6757	6644	6534	6427	6322
60	7639	7501	7368	7238	7112	6990	6871	6755	6642	6532	6425	6320
S	h m 0° 30′	h m 0° 31′	h m 0° 32′	h m 0° 33′	h m 0° 34′	h m 0° 35′	h m 0° 36′	h m 0° 37′	h m 0° 38′	h m 0° 39′	h m 0° 40′	h m 0° 41′

S	h m 1°30′	h m 1°31′	h m 1°32′	h m 1°33′	h m 1°34′	h m 1°35′	h m 1°36′	h m 1°37′	h m 1°38′	h m 1°39′	h m 1°40′	h m 1°41′
0	3010	2962	2915	2868	2821	2775	2730	2685	2640	2596	2553	2510
1	3009	2962	2914	2867	2821	2775	2729	2684	2640	2596	2552	2509
2	3009	2961	2913	2866	2820	2774	2729	2683	2639	2595	2551	2508
3	3008	2960	2912	2866	2819	2773	2728	2683	2638	2594	2551	2507
4	3007	2959	2912	2865	2818	2772	2727	2682	2638	2593	2550	2507
5	3006	2958	2911	2864	2818	2772	2726	2681	2637	2593	2549	2506
6	3005	2958	2910	2863	2817	2771	2725	2681	2636	2592	2548	2505
7	3005	2957	2909	2862	2816	2770	2725	2680	2635	2591	2548	2504
8	3004	2956	2909	2862	2815	2769	2724	2679	2635	2591	2547	2504
9	3003	2955	2908	2861	2815	2769	2723	2678	2634	2590	2546	2503
10	3002	2954	2907	2860	2814	2768	2722	2678	2633	2589	2545	2502
11	3001	2954	2906	2859	2813	2767	2722	2677	2632	2588	2545	2502
12	3001	2953	2905	2859	2812	2766	2721	2676	2632	2588	2544	2501
13	3000	2952	2905	2858	2811	2766	2720	2675	2631	2587	2543	2500
14	2999	2951	2904	2857	2811	2765	2719	2675	2630	2586	2543	2499
15	2998	2950	2903	2856	2810	2764	2719	2674	2629	2585	2542	2499
16	2997	2950	2902	2855	2809	2763	2718	2673	2629	2585	2541	2498
17	2997	2949	2901	2855	2808	2763	2717	2672	2628	2584	2540	2497
18	2996	2948	2901	2854	2808	2762	2716	2672	2627	2583	2540	2497
19	2995	2947	2900	2853	2807	2761	2716	2671	2626	2583	2539	2496
20	2994	2946	2899	2852	2806	2760	2715	2670	2626	2582	2538	2495
21	2993	2946	2898	2852	2805	2760	2714	2669	2625	2581	2538	2494
22	2993	2945	2898	2851	2805	2759	2713	2669	2624	2580	2537	2494
23	2992	2944	2897	2850	2804	2758	2713	2668	2624	2580	2536	2493
24	2991	2943	2896	2849	2803	2757	2712	2667	2623	2579	2535	2492
25	2990	2942	2895	2848	2802	2756	2711	2666	2622	2578	2535	2492
26	2989	2942	2894	2848	2801	2756	2710	2666	2621	2577	2534	2491
27	2989	2941	2894	2847	2801	2755	2710	2665	2621	2577	2533	2490
28	2988	2940	2893	2846	2800	2754	2709	2664	2620	2576	2533	2489
29	2987	2939	2892	2845	2799	2753	2708	2663	2619	2575	2532	2489
30	2986	2939	2891	2845	2798	2753	2707	2663	2618	2574	2531	2488
31	2985	2938	2891	2844	2798	2752	2707	2662	2618	2574	2530	2487
32	2985	2937	2890	2843	2797	2751	2706	2661	2617	2573	2530	2487
33	2984	2936	2889	2842	2796	2750	2705	2660	2616	2572	2529	2486
34	2983	2935	2888	2842	2795	2750	2704	2660	2615	2572	2528	2485
35	2982	2935	2887	2841	2795	2749	2704	2659	2615	2571	2527	2485
36	2981	2934	2887	2840	2794	2748	2703	2658	2614	2570	2527	2484
37	2981	2933	2886	2839	2793	2747	2702	2657	2613	2569	2526	2483
38	2980	2932	2885	2838	2792	2747	2701	2657	2612	2569	2525	2482
39	2979	2931	2884	2838	2792	2746	2701	2656	2612	2568	2525	2482
40	2978	2931	2883	2837	2791	2745	2700	2655	2611	2567	2524	2481
41	2977	2930	2883	2836	2790	2744	2699	2655	2610	2566	2523	2480
42	2977	2929	2882	2835	2789	2744	2698	2654	2610	2566	2522	2480
43	2976	2928	2881	2835	2788	2743	2698	2653	2609	2565	2522	2479
44	2975	2927	2880	2834	2788	2742	2697	2652	2608	2564	2521	2478
45	2974	2927	2880	2833	2787	2741	2696	2652	2607	2564	2520	2477
46	2973	2926	2879	2832	2786	2741	2696	2651	2607	2563	2520	2477
47	2973	2925	2878	2831	2785	2740	2695	2650	2606	2562	2519	2476
48	2972	2924	2877	2831	2785	2739	2694	2649	2605	2561	2518	2475
49	2971	2924	2876	2830	2784	2738	2693	2649	2604	2561	2517	2475
50	2970	2923	2876	2829	2783	2738	2692	2648	2604	2560	2517	2474
51	2969	2922	2875	2828	2782	2737	2692	2647	2603	2559	2516	2473
52	2969	2921	2874	2828	2782	2736	2691	2646	2602	2558	2515	2472
53	2968	2920	2873	2827	2781	2735	2690	2646	2601	2558	2515	2472
54	2967	2920	2873	2826	2780	2735	2689	2645	2601	2557	2514	2471
55	2966	2919	2872	2825	2779	2734	2689	2644	2600	2556	2513	2470
56	2965	2918	2871	2825	2779	2733	2688	2643	2599	2556	2512	2470
57	2965	2917	2870	2824	2778	2732	2687	2643	2599	2555	2512	2469
58	2964	2916	2869	2823	2777	2732	2687	2642	2598	2554	2511	2468
59	2963	2916	2869	2822	2776	2731	2686	2641	2597	2553	2510	2467
60	2962	2915	2868	2821	2775	2730	2685	2640	2596	2553	2510	2467
S	h m 1°30′	h m 1°31′	h m 1°32′	h m 1°33′	h m 1°34′	h m 1°35′	h m 1°36′	h m 1°37′	h m 1°38′	h m 1°39′	h m 1°40′	h m 1°41′

S	h m 1° 18′	h m 1° 19′	h m 1° 20′	h m 1° 21′	h m 1° 22′	h m 1° 23′	h m 1° 24′	h m 1° 25′	h m 1° 26′	h m 1° 27′	h m 1° 28′	h m 1° 29′
0	3632	3576	3522	3468	3415	3362	3310	3259	3208	3158	3108	3059
1	3631	3576	3521	3467	3414	3361	3309	3258	3207	3157	3107	3058
2	3630	3575	3520	3466	3413	3360	3308	3257	3206	3156	3106	3057
3	3629	3574	3519	3465	3412	3359	3307	3256	3205	3155	3105	3056
4	3628	3573	3518	3464	3411	3358	3306	3255	3204	3154	3105	3056
5	3627	3572	3517	3463	3410	3358	3306	3254	3204	3153	3104	3055
6	3626	3571	3516	3463	3409	3357	3305	3253	3203	3153	3103	3054
7	3625	3570	3515	3462	3408	3356	3304	3253	3202	3152	3102	3053
8	3624	3569	3514	3461	3408	3355	3303	3252	3201	3151	3101	3052
9	3623	3568	3514	3460	3407	3354	3302	3251	3200	3150	3101	3052
10	3623	3567	3513	3459	3406	3353	3301	3250	3199	3149	3100	3051
11	3622	3566	3512	3458	3405	3352	3300	3249	3198	3148	3099	3050
12	3621	3565	3511	3457	3404	3351	3300	3248	3198	3148	3098	3049
13	3620	3565	3510	3456	3403	3351	3299	3247	3197	3147	3097	3048
14	3619	3564	3509	3455	3402	3350	3298	3247	3196	3146	3096	3047
15	3618	3563	3508	3454	3401	3349	3297	3246	3195	3145	3096	3047
16	3617	3562	3507	3454	3400	3348	3296	3245	3194	3144	3095	3046
17	3616	3561	3506	3453	3400	3347	3295	3244	3193	3143	3094	3045
18	3615	3560	3506	3452	3399	3346	3294	3243	3193	3143	3093	3044
19	3614	3559	3505	3451	3398	3345	3294	3242	3192	3142	3092	3043
20	3613	3558	3504	3450	3397	3345	3293	3242	3191	3141	3091	3043
21	3612	3557	3503	3449	3396	3344	3292	3241	3190	3140	3091	3042
22	3611	3556	3502	3448	3395	3343	3291	3240	3189	3139	3090	3041
23	3610	3555	3501	3447	3394	3342	3290	3239	3188	3138	3089	3040
24	3610	3555	3500	3446	3393	3341	3289	3238	3188	3138	3088	3039
25	3609	3554	3499	3446	3393	3340	3288	3237	3187	3137	3087	3039
26	3608	3553	3498	3445	3392	3339	3288	3236	3186	3136	3087	3038
27	3607	3552	3497	3444	3391	3338	3287	3236	3185	3135	3086	3037
28	3606	3551	3497	3443	3390	3338	3286	3235	3184	3134	3085	3036
29	3605	3550	3496	3442	3389	3337	3285	3234	3183	3133	3084	3025
30	3604	3549	3495	3441	3388	3336	3284	3233	3183	3133	3083	3034
31	3603	3548	3494	3440	3387	3335	3283	3232	3182	3132	3082	3034
32	3602	3547	3493	3439	3386	3334	3282	3231	3181	3131	3082	3033
33	3601	3546	3492	3438	3386	3333	3282	3231	3180	3130	3081	3032
34	3600	3545	3491	3438	3385	3332	3281	3230	3179	3129	3080	3031
35	3599	3545	3490	3437	3384	3332	3280	3229	3178	3129	3079	3030
36	3598	3544	3489	3436	3383	3331	3279	3228	3178	3128	3078	3030
37	3598	3543	3488	3435	3382	3330	3278	3227	3177	3127	3078	3029
38	3597	3542	3488	3434	3381	3329	3277	3226	3176	3126	3077	3028
39	3596	3541	3487	3433	3380	3328	3276	3225	3175	3125	3076	3027
40	3595	3540	3486	3432	3379	3327	3276	3225	3174	3124	3075	3026
41	3594	3539	3485	3431	3379	3326	3275	3224	3173	3124	3074	3026
42	3593	3538	3484	3431	3378	3325	3274	3223	3173	3123	3073	3025
43	3592	3537	3483	3430	3377	3325	3273	3222	3172	3122	3073	3024
44	3591	3536	3482	3429	3376	3324	3272	3221	3171	3121	3072	3023
45	3590	3535	3481	3428	3375	3323	3271	3220	3170	3120	3071	3022
46	3589	3535	3480	3427	3374	3322	3270	3220	3169	3119	3070	3022
47	3588	3534	3480	3426	3373	3321	3270	3219	3168	3119	3069	3021
48	3587	3533	3479	3425	3372	3320	3269	3218	3168	3118	3069	3020
49	3587	3532	3478	3424	3371	3319	3268	3217	3167	3117	3068	3019
50	3586	3531	3477	3423	3371	3319	3267	3216	3166	3116	3067	3018
51	3585	3530	3476	3423	3370	3318	3266	3215	3165	3115	3066	3018
52	3584	3529	3475	3422	3369	3317	3265	3214	3164	3114	3065	3017
53	3583	3528	3474	3421	3368	3316	3265	3214	3163	3114	3065	3016
54	3582	3527	3473	3420	3367	3315	3264	3213	3163	3113	3064	3015
55	3581	3526	3472	3419	3366	3314	3263	3212	3162	3112	3063	3014
56	3580	3525	3471	3418	3365	3313	3262	3211	3161	3111	3062	3014
57	3579	3525	3471	3417	3365	3313	3261	3210	3160	3110	3061	3013
58	3578	3524	3470	3416	3364	3312	3260	3209	3159	3110	3060	3012
59	3577	3523	3469	3415	3363	3311	3259	3209	3158	3109	3060	3011
60	3576	3522	3468	3415	3362	3310	3259	3208	3158	3108	3059	3010
S	h m 1° 18′	h m 1° 19′	h m 1° 20′	h m 1° 21′	h m 1° 22′	h m 1° 23′	h m 1° 24′	h m 1° 25′	h m 1° 26′	h m 1° 27′	h m 1° 28′	h m 1° 29′

TABLE XXV. Proportional Logarithms.

S	h m 1°30′	h m 1°31′	h m 1°32′	h m 1°33′	h m 1°34′	h m 1°35′	h m 1°36′	h m 1°37′	h m 1°38′	h m 1°39′	h m 1°40′	h m 1°41′
0	3010	2962	2915	2868	2821	2775	2730	2685	2640	2596	2553	2510
1	3009	2962	2914	2867	2821	2775	2729	2684	2640	2596	2552	2509
2	3009	2961	2913	2866	2820	2774	2729	2683	2639	2595	2551	2508
3	3008	2960	2912	2866	2819	2773	2728	2683	2638	2594	2551	2507
4	3007	2959	2912	2865	2818	2772	2727	2682	2638	2593	2550	2507
5	3006	2958	2911	2864	2818	2772	2726	2681	2637	2593	2549	2506
6	3005	2958	2910	2863	2817	2771	2725	2681	2636	2592	2548	2505
7	3005	2957	2909	2862	2816	2770	2725	2680	2635	2591	2548	2504
8	3004	2956	2909	2862	2815	2769	2724	2679	2635	2591	2547	2504
9	3003	2955	2908	2861	2815	2769	2723	2678	2634	2590	2546	2503
10	3002	2954	2907	2860	2814	2768	2722	2678	2633	2589	2545	2502
11	3001	2954	2906	2859	2813	2767	2722	2677	2632	2588	2545	2502
12	3001	2953	2905	2859	2812	2766	2721	2676	2632	2588	2544	2501
13	3000	2952	2905	2858	2811	2766	2720	2675	2631	2587	2543	2500
14	2999	2951	2904	2857	2811	2765	2719	2675	2630	2586	2543	2499
15	2998	2950	2903	2856	2810	2764	2719	2674	2629	2585	2542	2499
16	2997	2950	2902	2855	2809	2763	2718	2673	2629	2585	2541	2498
17	2997	2949	2901	2855	2808	2763	2717	2672	2628	2584	2540	2497
18	2996	2948	2901	2854	2808	2762	2716	2672	2627	2583	2540	2497
19	2995	2947	2900	2853	2807	2761	2716	2671	2626	2583	2539	2496
20	2994	2946	2899	2852	2806	2760	2715	2670	2626	2582	2538	2495
21	2993	2946	2898	2852	2805	2760	2714	2669	2625	2581	2538	2494
22	2993	2945	2898	2851	2805	2759	2713	2669	2624	2580	2537	2494
23	2992	2944	2897	2850	2804	2758	2713	2668	2624	2580	2536	2493
24	2991	2943	2896	2849	2803	2757	2712	2667	2623	2579	2535	2492
25	2990	2942	2895	2848	2802	2756	2711	2666	2622	2578	2535	2492
26	2989	2942	2894	2848	2801	2756	2710	2666	2621	2577	2534	2491
27	2989	2941	2894	2847	2801	2755	2710	2665	2621	2577	2533	2490
28	2988	2940	2893	2846	2800	2754	2709	2664	2620	2576	2533	2489
29	2987	2939	2892	2845	2799	2753	2708	2663	2619	2575	2532	2489
30	2986	2939	2891	2845	2798	2753	2707	2663	2618	2574	2531	2488
31	2985	2938	2891	2844	2798	2752	2707	2662	2618	2574	2530	2487
32	2985	2937	2890	2843	2797	2751	2706	2661	2617	2573	2530	2487
33	2984	2936	2889	2842	2796	2750	2705	2660	2616	2572	2529	2486
34	2983	2935	2888	2842	2795	2750	2704	2660	2615	2572	2528	2485
35	2982	2935	2887	2841	2795	2749	2704	2659	2615	2571	2527	2485
36	2981	2934	2887	2840	2794	2748	2703	2658	2614	2570	2527	2484
37	2981	2933	2886	2839	2793	2747	2702	2657	2613	2569	2526	2483
38	2980	2932	2885	2838	2792	2747	2701	2657	2612	2569	2525	2482
39	2979	2931	2884	2838	2792	2746	2701	2656	2612	2568	2525	2482
40	2978	2931	2883	2837	2791	2745	2700	2655	2611	2567	2524	2481
41	2977	2930	2883	2836	2790	2744	2699	2655	2610	2566	2523	2480
42	2977	2929	2882	2835	2789	2744	2698	2654	2610	2566	2522	2480
43	2976	2928	2881	2835	2788	2743	2698	2653	2609	2565	2522	2479
44	2975	2927	2880	2834	2788	2742	2697	2652	2608	2564	2521	2478
45	2974	2927	2880	2833	2787	2741	2696	2652	2607	2564	2520	2477
46	2973	2926	2879	2832	2786	2741	2696	2651	2607	2563	2520	2477
47	2973	2925	2878	2831	2785	2740	2695	2650	2606	2562	2519	2476
48	2972	2924	2877	2831	2785	2739	2694	2649	2605	2561	2518	2475
49	2971	2924	2876	2830	2784	2738	2693	2649	2604	2561	2517	2475
50	2970	2923	2876	2829	2783	2738	2692	2648	2604	2560	2517	2474
51	2969	2922	2875	2828	2782	2737	2692	2647	2603	2559	2516	2473
52	2969	2921	2874	2828	2782	2736	2691	2646	2602	2558	2515	2472
53	2968	2920	2873	2827	2781	2735	2690	2646	2601	2558	2515	2472
54	2967	2920	2873	2826	2780	2735	2689	2645	2601	2557	2514	2471
55	2966	2919	2872	2825	2779	2734	2689	2644	2600	2556	2513	2470
56	2965	2918	2871	2825	2779	2733	2688	2643	2599	2556	2512	2470
57	2965	2917	2870	2824	2778	2732	2687	2643	2599	2555	2512	2469
58	2964	2916	2869	2823	2777	2732	2687	2642	2598	2554	2511	2468
59	2963	2916	2869	2822	2776	2731	2686	2641	2597	2553	2510	2467
60	2962	2915	2868	2821	2775	2730	2685	2640	2596	2553	2510	2467
S	h m 1°30′	h m 1°31′	h m 1°32′	h m 1°33′	h m 1°34′	h m 1°35′	h m 1°36′	h m 1°37′	h m 1°38′	h m 1°39′	h m 1°40′	h m 1°41′

11	2459	2417	2375	2333	2292	2251	[illegible]	[illegible]
12	2458	2416	2374	2333	2291	2251	2210	2170
13	2458	2415	2373	2332	2291	2250	2210	2170
14	2457	2415	2373	2331	2290	2249	2209	2169
15	2456	2414	2372	2331	2289	2249	2208	2169
16	2455	2413	2371	2330	2289	2248	2208	2168
17	2455	2412	2371	2329	2288	2247	2207	2167
18	2454	2412	2370	2328	2287	2247	2206	2167
19	2453	2411	2369	2328	2287	2246	2206	2166
20	2453	2410	2368	2327	2286	2245	2205	2165
21	2452	2410	2368	2326	2285	2245	2204	2165
22	2451	2409	2367	2326	2285	2244	2204	2164
23	2450	2408	2366	2325	2284	2243	2203	2163
24	2450	2408	2366	2324	2283	2243	2202	2163
25	2449	2407	2365	2324	2283	2242	2202	2162
26	2448	2406	2364	2323	2282	2241	2201	2161
27	2448	2405	2364	2322	2281	2241	2200	2161
28	2447	2405	2363	2322	2281	2240	2200	2160
29	2446	2404	2362	2321	2280	2239	2199	2159
30	2445	2403	2362	2320	2279	2239	2198	2159
31	2445	2403	2361	2320	2279	2238	2198	2158
32	2444	2402	2360	2319	2278	2237	2197	2157
33	2443	2401	2359	2318	2277	2237	2196	2157
34	2443	2401	2359	2317	2277	2236	2196	2156
35	2442	2400	2358	2317	2276	2235	2195	2155
36	2441	2399	2357	2316	2275	2235	2194	2155
37	2441	2398	2357	2315	2274	2234	2194	2154
38	2440	2398	2356	2315	2274	2233	2193	2153
39	2439	2397	2355	2314	2273	2233	2192	2153
40	2438	2396	2355	2313	2272	2232	2192	2152
41	2438	2396	2354	2313	2272	2231	2191	2151
42	2437	2395	2353	2312	2271	2231	2190	2151
43	2436	2394	2353	2311	2270	2230	2190	2150
44	2436	2394	2352	2311	2270	2229	2189	2149
45	2435	2393	2351	2310	2269	2229	2188	2149
46	2434	2392	2350	2309	2268	2228	2188	2148
47	2433	2391	2350	2309	2268	2227	2187	2147
48	2433	2391	2349	2308	2267	2227	2186	2147
49	2432	2390	2348	2307	2266	2226	2186	2146

S	h m 1° 54′	h m 1° 55′	h m 1° 56′	h m 1° 57′	h m 1° 58′	h m 1° 59′	h m 2° 0′	h m 2° 1′	h m 2° 2′	h m 2° 3′	h m 2° 4′
0	1984	1946	1908	1871	1834	1797	1761	1725	1689	1654	1619
1	1983	1945	1908	1870	1833	1797	1760	1724	1689	1653	1618
2	1982	1944	1907	1870	1833	1796	1760	1724	1688	1652	1617
3	1982	1944	1906	1869	1832	1795	1759	1723	1687	1652	1617
4	1981	1943	1906	1868	1831	1795	1759	1722	1687	1651	1616
5	1981	1943	1905	1868	1831	1794	1758	1722	1686	1651	1616
6	1980	1942	1904	1867	1830	1794	1757	1721	1686	1650	1615
7	1979	1941	1904	1867	1830	1793	1757	1721	1685	1650	1615
8	1979	1941	1903	1866	1829	1792	1756	1720	1684	1649	1614
9	1978	1940	1903	1865	1828	1792	1755	1719	1684	1648	1613
10	1977	1939	1902	1865	1828	1791	1755	1719	1683	1648	1613
11	1977	1939	1901	1864	1827	1791	1754	1718	1683	1647	1612
12	1976	1938	1901	1863	1827	1790	1754	1718	1682	1647	1612
13	1975	1938	1900	1863	1826	1789	1753	1717	1681	1646	1611
14	1975	1937	1899	1862	1825	1789	1752	1717	1681	1645	1610
15	1974	1936	1899	1862	1825	1788	1752	1716	1680	1645	1610
16	1974	1936	1898	1861	1824	1788	1751	1715	1680	1644	1609
17	1973	1935	1898	1860	1823	1787	1751	1715	1679	1644	1609
18	1972	1934	1897	1860	1823	1786	1750	1714	1678	1643	1608
19	1972	1934	1896	1859	1822	1786	1749	1714	1678	1643	1607
20	1971	1933	1896	1859	1822	1785	1749	1713	1677	1642	1607
21	1970	1933	1895	1858	1821	1785	1748	1712	1677	1641	1606
22	1970	1932	1894	1857	1820	1784	1748	1712	1676	1641	1606
23	1969	1931	1894	1857	1820	1783	1747	1711	1676	1640	1605
24	1968	1931	1893	1856	1819	1783	1746	1711	1675	1640	1605
25	1968	1930	1893	1855	1819	1782	1746	1710	1674	1639	1604
26	1967	1929	1892	1855	1818	1781	1745	1709	1674	1638	1603
27	1967	1929	1891	1854	1817	1781	1745	1709	1673	1638	1603
28	1966	1928	1891	1854	1817	1780	1744	1708	1673	1637	1602
29	1965	1928	1890	1853	1816	1780	1743	1708	1672	1637	1602
30	1965	1927	1889	1852	1816	1779	1743	1707	1671	1636	1601
31	1964	1926	1889	1852	1815	1778	1742	1706	1671	1635	1600
32	1963	1926	1888	1851	1814	1778	1742	1706	1670	1635	1600
33	1963	1925	1888	1850	1814	1777	1741	1705	1670	1634	1599
34	1962	1924	1887	1850	1813	1777	1740	1705	1669	1634	1599
35	1962	1924	1886	1849	1812	1776	1740	1704	1668	1633	1598
36	1961	1923	1886	1849	1812	1775	1739	1703	1668	1633	1598
37	1960	1923	1885	1848	1811	1775	1739	1703	1667	1632	1597
38	1960	1922	1884	1847	1811	1774	1738	1702	1667	1631	1596
39	1959	1921	1884	1847	1810	1774	1737	1702	1666	1631	1596
40	1958	1921	1883	1846	1809	1773	1737	1701	1665	1630	1595
41	1958	1920	1883	1846	1809	1772	1736	1700	1665	1630	1595
42	1957	1919	1882	1845	1808	1772	1736	1700	1664	1629	1594
43	1956	1919	1881	1844	1808	1771	1735	1699	1664	1628	1593
44	1956	1918	1881	1844	1807	1771	1734	1699	1663	1628	1593
45	1955	1918	1880	1843	1806	1770	1734	1698	1663	1627	1592
46	1955	1917	1880	1843	1806	1769	1733	1697	1662	1627	1592
47	1954	1916	1879	1842	1805	1769	1733	1697	1661	1626	1591
48	1953	1916	1878	1841	1805	1768	1732	1696	1661	1626	1591
49	1953	1915	1878	1841	1804	1768	1731	1696	1660	1625	1590
50	1952	1914	1877	1840	1803	1767	1731	1695	1660	1624	1589
51	1951	1914	1876	1839	1803	1766	1730	1694	1659	1624	1589
52	1951	1913	1876	1839	1802	1766	1730	1694	1658	1623	1588
53	1950	1913	1875	1838	1802	1765	1729	1693	1658	1623	1588
54	1950	1912	1875	1838	1801	1765	1728	1693	1657	1622	1587
55	1949	1911	1874	1837	1800	1764	1728	1692	1657	1621	1587
56	1948	1911	1873	1836	1800	1763	1727	1692	1656	1621	1586
57	1948	1910	1873	1836	1799	1763	1727	1691	1655	1620	1585
58	1947	1909	1872	1835	1798	1762	1726	1690	1655	1620	1585
59	1946	1909	1871	1835	1798	1762	1725	1690	1654	1619	1584
60	1946	1908	1871	1834	1797	1761	1725	1689	1654	1619	1584
S	h m 1° 54′	h m 1° 55′	h m 1° 56′	h m 1° 57′	h m 1° 58′	h m 1° 59′	h m 2° 0′	h m 2° 1′	h m 2° 2′	h m 2° 3′	h m 2° 4′

S	h m 1° 42′	h m 1° 43′	h m 1° 44′	h m 1° 45′	h m 1° 46′	h m 1° 47′	h m 1° 48′	h m 1° 49′	h m 1° 50′	h m 1° 51′	h m 1° 52′	h m 1° 53′
0	2467	2424	2382	2341	2300	2259	2218	2178	2139	2099	2061	2022
1	2466	2424	2382	2340	2299	2258	2218	2178	2138	2099	2060	2021
2	2465	2423	2381	2339	2298	2258	2217	2177	2137	2098	2059	2021
3	2465	2422	2380	2339	2298	2257	2216	2176	2137	2098	2059	2020
4	2464	2422	2380	2338	2297	2256	2216	2176	2136	2097	2058	2019
5	2463	2421	2379	2337	2296	2256	2215	2175	2136	2096	2057	2019
6	2462	2420	2378	2337	2396	2255	2214	2174	2135	2096	2057	2018
7	2462	2419	2378	2336	2295	2254	2214	2174	2134	2095	2056	2017
8	2461	2419	2377	2335	2294	2253	2213	2173	2134	2094	2055	2017
9	2460	2418	2376	2335	2294	2253	2212	2172	2133	2094	2055	2016
10	2460	2417	2375	2334	2293	2252	2212	2172	2132	2093	2054	2016
11	2459	2417	2375	2333	2292	2251	2211	2171	2132	2092	2053	2015
12	2458	2416	2374	2333	2291	2251	2210	2170	2131	2092	2053	2014
13	2458	2415	2373	2332	2291	2250	2210	2170	2130	2091	2052	2014
14	2457	2415	2373	2331	2290	2249	2209	2169	2130	2090	2052	2013
15	2456	2414	2372	2331	2289	2249	2208	2169	2129	2090	2051	2012
16	2455	2413	2371	2330	2289	2248	2208	2168	2128	2089	2050	2012
17	2455	2412	2371	2329	2288	2247	2207	2167	2128	2088	2050	2011
18	2454	2412	2370	2328	2287	2247	2206	2167	2127	2088	2049	2010
19	2453	2411	2369	2328	2287	2246	2206	2166	2126	2087	2048	2010
20	2453	2410	2368	2327	2286	2245	2205	2165	2126	2086	2048	2009
21	2452	2410	2368	2326	2285	2245	2204	2165	2125	2086	2047	2009
22	2451	2409	2367	2326	2285	2244	2204	2164	2124	2085	2046	2008
23	2450	2408	2366	2325	2284	2243	2203	2163	2124	2085	2046	2007
24	2450	2408	2366	2324	2283	2243	2202	2163	2123	2084	2045	2007
25	2449	2407	2365	2324	2283	2242	2202	2162	2122	2083	2044	2006
26	2448	2406	2364	2323	2282	2241	2201	2161	2122	2083	2044	2005
27	2448	2405	2364	2322	2281	2241	2200	2161	2121	2082	2043	2005
28	2447	2405	2363	2322	2281	2240	2200	2160	2120	2081	2042	2004
29	2446	2404	2362	2321	2280	2239	2199	2159	2120	2081	2042	2003
30	2445	2403	2362	2320	2279	2239	2198	2159	2119	2080	2041	2003
31	2445	2403	2361	2320	2279	2238	2198	2158	2118	2079	2041	2002
32	2444	2402	2360	2319	2278	2237	2197	2157	2118	2079	2040	2001
33	2443	2401	2359	2318	2277	2237	2196	2157	2117	2078	2039	2001
34	2443	2401	2359	2317	2277	2236	2196	2156	2116	2077	2039	2000
35	2442	2400	2358	2317	2276	2235	2195	2155	2116	2077	2038	2000
36	2441	2399	2357	2316	2275	2235	2194	2155	2115	2076	2037	1999
37	2441	2398	2357	2315	2274	2234	2194	2154	2115	2075	2037	1998
38	2440	2398	2356	2315	2274	2233	2193	2153	2114	2075	2036	1998
39	2439	2397	2355	2314	2273	2233	2192	2153	2113	2074	2035	1997
40	2438	2396	2355	2313	2272	2232	2192	2152	2113	2073	2035	1996
41	2438	2396	2354	2313	2272	2231	2191	2151	2112	2073	2034	1996
42	2437	2395	2353	2312	2271	2231	2190	2151	2111	2072	2033	1995
43	2436	2394	2353	2311	2270	2230	2190	2150	2111	2072	2033	1994
44	2436	2394	2352	2311	2270	2229	2189	2149	2110	2071	2032	1994
45	2435	2393	2351	2310	2269	2229	2188	2149	2109	2070	2032	1993
46	2434	2392	2350	2309	2268	2228	2188	2148	2109	2070	2031	1993
47	2433	2391	2350	2309	2268	2227	2187	2147	2108	2069	2030	1992
48	2433	2391	2349	2308	2267	2227	2186	2147	2107	2068	2030	1991
49	2432	2390	2348	2307	2266	2226	2186	2146	2107	2068	2029	1991
50	2431	2389	2348	2307	2266	2225	2185	2145	2106	2067	2028	1990
51	2431	2389	2347	2306	2265	2225	2184	2145	2105	2066	2028	1989
52	2430	2388	2346	2305	2264	2224	2184	2144	2105	2066	2027	1989
53	2429	2387	2346	2304	2264	2223	2183	2143	2104	2065	2026	1988
54	2429	2387	2345	2304	2263	2223	2182	2143	2103	2064	2026	1987
55	2428	2386	2344	2303	2262	2222	2182	2142	2103	2064	2025	1987
56	2427	2385	2344	2302	2262	2221	2181	2141	2102	2063	2025	1986
57	2426	2384	2343	2302	2261	2220	2180	2141	2101	2062	2024	1986
58	2426	2384	2342	2301	2260	2220	2180	2140	2101	2062	2023	1985
59	2425	2383	2342	2300	2260	2219	2179	2139	2100	2061	2023	1984
60	2424	2382	2341	2300	2259	2218	2178	2139	2099	2061	2022	1984
S	h m 1° 42′	h m 1° 43′	h m 1° 44′	h m 1° 45′	h m 1° 46′	h m 1° 47′	h m 1° 48′	h m 1° 49′	h m 1° 50′	h m 1° 51′	h m 1° 52′	h m 1° 53′

S	h m 2° 16′	h m 2° 17′	h m 2° 18′	h m 2° 19′	h m 2° 20′	h m 2° 21′	h m 2° 22′	h m 2° 23′	h m 2° 24′	h m 2° 25′	h m 2° 26′
0	1217	1186	1154	1123	1091	1061	1030	0999	0969	0939	0909
1	1217	1185	1153	1122	1091	1060	1029	999	969	939	909
2	1216	1184	1153	1122	1090	1060	1029	998	968	938	908
3	1216	1184	1152	1121	1090	1059	1028	998	968	938	908
4	1215	1183	1152	1120	1089	1058	1028	997	967	937	907
5	1215	1183	1151	1120	1089	1058	1027	997	967	937	907
6	1214	1182	1151	1119	1088	1057	1027	996	966	936	906
7	1214	1182	1150	1119	1088	1057	1026	996	966	936	906
8	1213	1181	1150	1118	1087	1056	1026	995	965	935	905
9	1213	1181	1149	1118	1087	1056	1025	995	965	935	905
10	1212	1180	1149	1117	1086	1055	1025	0994	0964	0934	0904
11	1211	1180	1148	1117	1086	1055	1024	994	964	934	904
12	1211	1179	1148	1116	1085	1054	1024	993	963	933	903
13	1210	1179	1147	1116	1085	1054	1023	993	963	933	903
14	1210	1178	1147	1115	1084	1053	1023	992	962	932	902
15	1209	1178	1146	1115	1084	1053	1022	992	962	932	902
16	1209	1177	1146	1114	1083	1052	1022	991	961	931	901
17	1208	1177	1145	1114	1083	1052	1021	991	961	931	901
18	1208	1176	1145	1113	1082	1051	1021	990	960	930	900
19	1207	1175	1144	1113	1082	1051	1020	990	960	930	900
20	1207	1175	1143	1112	1081	1050	1020	0989	0959	0929	0899
21	1206	1174	1143	1112	1081	1050	1019	989	959	929	899
22	1206	1174	1142	1111	1080	1049	1019	988	958	928	898
23	1205	1173	1142	1111	1080	1049	1018	988	958	928	898
24	1205	1173	1141	1110	1079	1048	1018	987	957	927	897
25	1204	1172	1141	1110	1079	1048	1017	987	957	927	897
26	1204	1172	1140	1109	1078	1047	1017	986	956	926	896
27	1203	1171	1140	1109	1078	1047	1016	986	956	926	896
28	1202	1171	1139	1108	1077	1046	1016	985	955	925	895
29	1202	1170	1139	1108	1076	1046	1015	985	955	925	895
30	1201	1170	1138	1107	1076	1045	1015	0984	0954	0924	0894
31	1201	1169	1138	1106	1075	1045	1014	984	954	924	894
32	1200	1169	1137	1106	1075	1044	1014	983	953	923	893
33	1200	1168	1137	1105	1074	1044	1013	983	953	923	893
34	1199	1168	1136	1105	1074	1043	1013	982	952	922	892
35	1199	1167	1136	1104	1073	1043	1012	982	952	922	892
36	1198	1167	1135	1104	1073	1042	1012	981	951	921	891
37	1198	1166	1135	1103	1072	1042	1011	981	951	921	891
38	1197	1165	1134	1103	1072	1041	1011	980	950	920	890
39	1197	1165	1134	1102	1071	1041	1010	980	950	920	890
40	1196	1164	1133	1102	1071	1040	1009	0979	0949	0919	0889
41	1196	1164	1132	1101	1070	1040	1009	979	949	919	889
42	1195	1163	1132	1101	1070	1039	1008	978	948	918	888
43	1195	1163	1131	1100	1069	1039	1008	978	948	918	888
44	1194	1162	1131	1100	1069	1038	1007	977	947	917	887
45	1193	1162	1130	1099	1068	1037	1007	977	947	917	887
46	1193	1161	1130	1099	1068	1037	1006	976	946	916	886
47	1192	1161	1129	1098	1067	1036	1006	976	946	916	886
48	1192	1160	1129	1098	1067	1036	1005	975	945	915	885
49	1191	1160	1128	1097	1066	1035	1005	975	945	915	885
50	1191	1159	1128	1097	1066	1035	1004	0974	0944	0914	0884
51	1190	1159	1127	1096	1065	1034	1004	974	944	914	884
52	1190	1158	1127	1096	1065	1034	1003	973	943	913	883
53	1189	1158	1126	1095	1064	1033	1003	973	943	913	883
54	1189	1157	1126	1095	1064	1033	1002	972	942	912	883
55	1188	1157	1125	1094	1063	1032	1002	972	942	912	882
56	1188	1156	1125	1094	1063	1032	1001	971	941	911	882
57	1187	1156	1124	1093	1062	1031	1001	971	941	911	881
58	1187	1155	1124	1092	1062	1031	1000	970	940	910	881
59	1186	1154	1123	1092	1061	1030	1000	970	940	910	880
60	1186	1154	1123	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	939	0909	0880
S	h m 2° 16′	h m 2° 17′	h m 2° 18′	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	h m 2° 25′	h m 2° 26′

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	1577	1542	1508	1474	1440	1407	1373	134[illegible]
13	1576	1542	1507	1473	1440	1406	1373	134[illegible]
14	1576	1541	1507	1473	1439	1406	1372	133[illegible]
15	1575	1540	1506	1472	1438	1405	1372	133[illegible]
16	1574	1540	1506	1472	1438	1404	1371	133[illegible]
17	1574	1539	1505	1471	1437	1404	1371	133[illegible]
18	1573	1539	1504	1470	1437	1403	1370	1337
19	1573	1538	1504	1470	1436	1403	1370	1337
20	1572	1538	1503	1469	1436	1402	1369	1336
21	1571	1537	1503	1469	1435	1402	1368	1335
22	1571	1536	1502	1468	1435	1401	1368	1335
23	1570	1536	1502	1468	1134	1401	1367	1334
24	1570	1535	1501	1467	1433	1400	1367	1334
25	1569	1535	1500	1467	1433	1399	1366	1333
26	1569	1534	1500	1466	1432	1399	1366	1333
27	1568	1534	1499	1465	1432	1398	1365	1332
28	1567	1533	1499	1465	1431	1398	1365	1332
29	1567	1532	1498	1464	1430	1397	1364	1331
30	1566	1532	1498	1464	1430	1397	1363	1331
31	1566	1531	1497	1463	1429	1396	1363	1330
32	1565	1531	1496	1463	1429	1396	1362	1329
33	1565	1530	1496	1462	1428	1395	1362	1329
34	1564	1530	1495	1461	1428	1394	1361	1328
35	1563	1529	1495	1461	1427	1394	1361	1328
36	1563	1528	1494	1460	1427	1393	1360	1327
37	1562	1528	1494	1460	1426	1393	1360	1327
38	1562	1527	1493	1459	1426	1392	1359	1326
39	1561	1527	1493	1459	1425	1392	1359	1326
40	1561	1526	1492	1458	1424	1391	1358	1325
41	1560	1526	1491	1458	1424	1391	1357	1325
42	1559	1525	1491	1457	1423	1390	1357	1324
43	1559	1524	1490	1456	1423	1389	1356	1323
44	1558	1524	1490	1456	1422	1389	1356	1323
45	1558	1523	1489	1455	1422	1388	1355	1322
46	1557	1523	1489	1455	1421	1388	1355	1322
47	1556	1522	1488	1454	1421	1387	1354	1321
48	1556	1522	1487	1454	1420	1387	1354	1321

TABLE XXV. Proportional Logarithms.

S	h m 2° 16′	h m 2° 17′	h m 2° 18′	h m 2° 19′	h m 2° 20′	h m 2° 21′	h m 2° 22′	h m 2° 23′	h m 2° 24′	h m 2° 25′	h m 2° 26′
0	1217	1186	1154	1123	1091	1061	1030	0999	0969	0939	0909
1	1217	1185	1153	1122	1091	1060	1029	999	969	939	909
2	1216	1184	1153	1122	1090	1060	1029	998	968	938	908
3	1216	1184	1152	1121	1090	1059	1028	998	968	938	908
4	1215	1183	1152	1120	1089	1058	1028	997	967	937	907
5	1215	1183	1151	1120	1089	1058	1027	997	967	937	907
6	1214	1182	1151	1119	1088	1057	1027	996	966	936	906
7	1214	1182	1150	1119	1088	1057	1026	996	966	936	906
8	1213	1181	1150	1118	1087	1056	1026	995	965	935	905
9	1213	1181	1149	1118	1087	1056	1025	995	965	935	905
10	1212	1180	1149	1117	1086	1055	1025	0994	0964	0934	0904
11	1211	1180	1148	1117	1086	1055	1024	994	964	934	904
12	1211	1179	1148	1116	1085	1054	1024	993	963	933	903
13	1210	1179	1147	1116	1085	1054	1023	993	963	933	903
14	1210	1178	1147	1115	1084	1053	1023	992	962	932	902
15	1209	1178	1146	1115	1084	1053	1022	992	962	932	902
16	1209	1177	1146	1114	1083	1052	1022	991	961	931	901
17	1208	1177	1145	1114	1083	1052	1021	991	961	931	901
18	1208	1176	1145	1113	1082	1051	1021	990	960	930	900
19	1207	1175	1144	1113	1082	1051	1020	990	960	930	900
20	1207	1175	1143	1112	1081	1050	1020	0989	0959	0929	0899
21	1206	1174	1143	1112	1081	1050	1019	989	959	929	899
22	1206	1174	1142	1111	1080	1049	1019	988	958	928	898
23	1205	1173	1142	1111	1080	1049	1018	988	958	928	898
24	1205	1173	1141	1110	1079	1048	1018	987	957	927	897
25	1204	1172	1141	1110	1079	1048	1017	987	957	927	897
26	1204	1172	1140	1109	1078	1047	1017	986	956	926	896
27	1203	1171	1140	1109	1078	1047	1016	986	956	926	896
28	1202	1171	1139	1108	1077	1046	1016	985	955	925	895
29	1202	1170	1139	1108	1076	1046	1015	985	955	925	895
30	1201	1170	1138	1107	1076	1045	1015	0984	0954	0924	0894
31	1201	1169	1138	1106	1075	1045	1014	984	954	924	894
32	1200	1169	1137	1106	1075	1044	1014	983	953	923	893
33	1200	1168	1137	1105	1074	1044	1013	983	953	923	893
34	1199	1168	1136	1105	1074	1043	1013	982	952	922	892
35	1199	1167	1136	1104	1073	1043	1012	982	952	922	892
36	1198	1167	1135	1104	1073	1042	1012	981	951	921	891
37	1198	1166	1135	1103	1072	1042	1011	981	951	921	891
38	1197	1165	1134	1103	1072	1041	1011	980	950	920	890
39	1197	1165	1134	1102	1071	1041	1010	980	950	920	890
40	1196	1164	1133	1102	1071	1040	1009	0979	0949	0919	0889
41	1196	1164	1132	1101	1070	1040	1009	979	949	919	889
42	1195	1163	1132	1101	1070	1039	1008	978	948	918	888
43	1195	1163	1131	1100	1069	1039	1008	978	948	918	888
44	1194	1162	1131	1100	1069	1038	1007	977	947	917	887
45	1193	1162	1130	1099	1068	1037	1007	977	947	917	887
46	1193	1161	1130	1099	1068	1037	1006	976	946	916	886
47	1192	1161	1129	1098	1067	1036	1006	976	946	916	886
48	1192	1160	1129	1098	1067	1036	1005	975	945	915	885
49	1191	1160	1128	1097	1066	1035	1005	975	945	915	885
50	1191	1159	1128	1097	1066	1035	1004	0974	0944	0914	0884
51	1190	1159	1127	1096	1065	1034	1004	974	944	914	884
52	1190	1158	1127	1096	1065	1034	1003	973	943	913	883
53	1189	1158	1126	1095	1064	1033	1003	973	943	913	883
54	1189	1157	1126	1095	1064	1033	1002	972	942	912	883
55	1188	1157	1125	1094	1063	1032	1002	972	942	912	882
56	1188	1156	1125	1094	1063	1032	1001	971	941	911	882
57	1187	1156	1124	1093	1062	1031	1001	971	941	911	881
58	1187	1155	1124	1092	1062	1031	1000	970	940	910	881
59	1186	1154	1123	1092	1061	1030	1000	970	940	910	880
60	1186	1154	1123	1091	1061	1030	0999	0969	0939	0909	0880
S	h m 2° 16′	h m 2° 17′	h m 2° 18′	h m 2° 19′	h m 2° 20′	h m 2° 21′	h m 2° 22′	h m 2° 23′	h m 2° 24′	h m 2° 25′	h m 2° 26′

S	h m 2° 27′	h m 2° 28′	h m 2° 29′	h m 2° 30′	h m 2° 31′	h m 2° 32′	h m 2° 33′	h m 2° 34′	h m 2° 35′	h m 2° 36′	h m 2° 37′
0	0880	0850	0821	0792	0763	0734	0706	0678	0649	0621	0594
1	879	850	820	791	762	734	705	677	649	621	593
2	879	849	820	791	762	733	705	677	648	621	593
3	878	849	819	790	762	733	704	676	648	620	592
4	878	848	819	790	761	732	704	676	648	620	592
5	877	848	818	789	761	732	703	675	647	619	591
6	877	847	818	789	760	731	703	675	647	619	591
7	876	847	817	788	760	731	703	674	646	618	591
8	876	846	817	788	759	730	702	674	646	618	590
9	875	846	816	787	759	730	702	673	645	617	590
10	0875	0845	0816	0787	0758	0730	0701	0673	0645	0617	0589
11	874	845	816	787	758	729	701	672	644	616	589
12	874	844	815	786	757	729	700	672	644	616	588
13	873	844	815	786	757	728	700	671	643	615	588
14	873	843	814	785	756	728	699	671	643	015	587
15	872	843	814	785	756	727	699	670	642	615	587
16	872	842	813	784	755	727	698	670	642	614	586
17	871	842	813	784	755	726	698	670	641	614	586
18	871	841	812	783	754	726	697	669	641	613	585
19	870	841	812	783	754	725	697	669	641	613	585
20	0870	0840	0811	0782	0753	0725	0696	0668	0640	0612	0585
21	869	840	811	782	753	724	696	668	640	612	584
22	869	839	810	781	752	724	695	667	639	611	584
23	868	839	810	781	752	723	695	667	639	611	583
24	868	838	809	780	751	723	695	666	638	610	583
25	867	838	809	780	751	722	694	666	638	610	582
26	867	837	808	779	751	722	694	665	637	609	582
27	866	837	808	779	750	721	693	665	637	609	581
28	866	836	807	778	750	721	693	664	636	609	581
29	865	836	807	778	749	721	692	664	636	608	580
30	0865	0835	0806	0777	0749	0720	0692	0663	0635	0608	0580
31	864	835	806	777	748	720	691	663	635	607	579
32	864	834	805	776	748	719	691	663	635	607	579
33	863	834	805	776	747	719	690	662	634	606	579
34	863	834	804	775	747	718	690	662	634	606	578
35	862	833	804	775	746	718	689	661	633	605	578
36	862	833	803	774	746	717	689	661	633	605	577
37	861	832	803	774	745	717	688	660	632	604	577
38	861	832	802	774	745	716	688	660	632	604	576
39	860	831	802	773	744	716	687	659	631	603	576
40	0860	0831	0801	0773	0744	0715	0687	0659	0631	0603	0575
41	859	830	801	772	743	715	686	658	630	602	575
42	859	830	801	772	743	714	686	658	630	602	574
43	858	829	800	771	742	714	686	657	629	602	574
44	858	829	800	771	742	713	685	657	629	601	573
45	857	828	799	770	741	713	685	656	628	601	573
46	857	828	799	770	741	712	684	656	628	600	573
47	856	827	798	769	740	712	684	655	628	600	572
48	856	827	798	769	740	711	683	655	627	599	572
49	855	826	797	768	740	711	683	655	627	599	571
50	0855	0826	0797	0768	0739	0711	0682	0654	0626	0598	0571
51	855	825	796	767	739	710	682	654	626	598	570
52	854	825	796	767	738	710	681	653	625	597	570
53	854	824	795	766	738	709	681	653	625	597	569
54	853	824	795	766	737	709	680	652	624	596	569
55	853	823	794	765	737	708	680	652	624	596	568
56	852	823	794	765	736	708	679	651	623	596	568
57	852	822	793	764	736	707	679	651	623	595	568
58	851	822	793	764	735	707	678	650	622	595	567
59	851	821	792	763	735	706	678	650	622	594	567
60	0850	0821	0792	0763	0734	0706	0678	0649	0621	0594	0566
S	h m 2° 27′	h m 2° 28′	h m 2° 29′	h m 2° 30′	h m 2° 31′	h m 2° 32′	h m 2° 33′	h m 2° 34′	h m 2° 35′	h m 2° 36′	h m 2° 37′

S	h m 2° 38′	h m 2° 39′	h m 2° 40′	h m 2° 41′	h m 2° 42′	h m 2° 43′	h m 2° 44′	h m 2° 45′	h m 2° 46′	h m 2° 47′	h m 2° 48′
0	0566	0539	0512	0484	0458	0431	0404	0378	0352	0326	0300
1	566	538	511	484	457	430	404	377	351	325	299
2	565	538	511	484	457	430	403	377	351	325	299
3	565	537	510	483	456	430	403	377	350	324	298
4	564	537	510	483	456	429	403	376	350	324	298
5	564	536	509	482	455	429	402	376	349	323	297
6	563	536	509	482	455	428	402	375	349	323	297
7	563	536	508	481	454	428	401	375	349	323	297
8	562	535	508	481	454	427	401	374	348	322	296
9	562	535	507	480	454	427	400	374	348	322	296
10	0562	0534	0507	0480	0453	0426	0400	0374	0347	0321	0295
11	561	534	507	480	453	426	399	373	347	321	295
12	561	533	506	479	452	426	399	373	346	320	294
13	560	533	506	479	452	425	399	372	346	320	294
14	560	532	505	478	451	425	398	372	346	319	294
15	559	532	505	478	451	424	398	371	345	319	293
16	559	531	504	477	450	424	397	371	345	319	293
17	558	531	504	477	450	423	397	370	344	318	292
18	558	531	503	476	450	423	396	370	344	318	292
19	557	530	503	476	449	422	396	370	343	317	291
20	0557	0530	0502	0475	0449	0422	0395	0369	0343	0317	0291
21	557	529	502	475	448	422	395	369	342	316	291
22	556	529	502	475	448	421	395	368	342	316	290
23	556	528	501	474	447	421	394	368	342	316	290
24	555	528	501	474	447	420	394	367	341	315	289
25	555	527	500	473	446	420	393	367	341	315	289
26	554	527	500	473	446	419	393	366	340	314	288
27	554	526	499	472	446	419	392	366	340	314	288
28	553	526	499	472	445	418	392	366	339	313	288
29	553	526	498	471	445	418	391	365	339	313	287
30	0552	0525	0498	0471	0444	0418	0391	0365	0339	0313	0287
31	552	525	498	471	444	417	391	364	338	312	286
32	552	524	497	470	443	417	390	364	338	312	286
33	551	524	497	470	443	416	390	363	337	311	285
34	551	523	496	469	442	416	389	363	337	311	285
35	550	523	496	469	442	415	389	363	336	310	285
36	550	522	495	468	442	415	388	362	336	310	284
37	549	522	495	468	441	414	388	362	336	310	284
38	549	521	494	467	441	414	388	361	335	309	283
39	548	521	494	467	440	414	387	361	335	309	283
40	0548	0521	0493	0467	0440	0413	0387	0360	0334	0308	0282
41	547	520	493	466	439	413	386	360	334	308	282
42	547	520	493	466	439	412	386	360	333	307	282
43	546	519	492	465	438	412	385	359	333	307	281
44	546	519	492	465	438	411	385	359	333	307	281
45	546	518	491	464	438	411	384	358	332	306	280
46	545	518	491	464	437	410	384	358	332	306	280
47	545	517	490	463	437	410	384	357	331	305	279
48	544	517	490	463	436	410	383	357	331	305	279
49	544	517	489	462	436	409	383	356	330	304	279
50	0543	0516	0489	0462	0435	0409	0382	0356	0330	0304	0278
51	543	516	489	462	435	408	382	356	329	304	278
52	542	515	488	461	434	408	381	355	329	303	277
53	542	515	488	461	434	407	381	355	329	303	277
54	541	514	487	460	434	407	381	354	328	302	276
55	541	514	487	460	433	406	380	354	328	302	276
56	541	513	486	459	433	406	380	353	327	301	276
57	540	513	486	459	432	406	379	353	327	301	275
58	540	512	485	458	432	405	379	353	326	300	275
59	539	512	485	458	431	405	378	352	326	300	274
60	0539	0512	0484	0458	0431	0404	0378	0352	0326	0300	0274
S	h m 2° 38′	h m 2° 39′	h m 2° 40′	h m 2° 41′	h m 2° 42′	h m 2° 43′	h m 2° 44′	h m 2° 45′	h m 2° 46′	h m 2° 47′	h m 2° 48′

BLE XXV. PROPORTIONAL LOGARITHMS.

		h m 2° 50′	h m 2° 51′	h m 2° 52′	h m 2° 53′	h m 2° 54′	h m 2° 55′	h m 2° 56′	h m 2° 57′	h m 2° 58′	h m 2° 59′
		0248	0223	0197	0172	0147	0122	0098	0073	0049	0024
		248	222	197	172	147	122	97	73	48	24
		247	222	197	171	146	122	97	72	48	23
	3	247	221	196	171	146	121	96	72	47	23
	2	247	221	196	171	146	121	96	71	47	23
	72	246	221	195	170	145	120	96	71	46	22
	71	246	220	195	170	145	120	95	71	46	22
	71	245	220	194	169	144	119	95	70	46	21
	270	245	219	194	169	144	119	94	70	45	21
	270	244	219	194	169	143	119	94	69	45	21
	0270	0244	0219	0193	0168	0143	0118	0093	0069	0044	0020
	269	244	218	193	168	143	118	93	68	44	20
	269	243	218	192	167	142	117	93	68	44	19
	268	243	217	192	167	142	117	92	68	43	19
	268	242	217	192	166	141	117	92	67	43	19
	267	242	216	191	166	141	116	91	67	42	18
	267	241	216	191	166	141	116	91	66	42	18
	267	241	216	190	165	140	115	91	66	42	17
	266	241	215	190	165	140	115	90	66	41	17
	266	240	215	189	164	139	114	90	65	41	17
0	0265	0240	0214	0189	0164	0139	0114	0089	0065	0040	0016
21	265	239	214	189	163	139	114	89	64	40	16
22	264	239	213	188	163	138	113	89	64	40	15
23	264	238	213	188	163	138	113	88	64	39	15
24	264	238	213	187	162	137	112	88	63	39	15
25	263	238	212	187	162	137	112	87	63	38	14
26	263	237	212	187	161	136	112	87	62	38	14
27	262	237	211	186	161	136	111	87	62	38	13
28	262	236	211	186	161	136	111	86	62	37	13
29	261	236	211	185	160	135	110	86	61	37	12
30	0261	0235	0210	0185	0160	0135	0110	0085	0061	0036	0012
	261	235	210	184	159	134	110	85	60	36	12
		235	209	184	159	134	109	84	60	36	11
				184	158	134	109	84	60	35	11
						133	108	84	59	35	10
								83	59	34	10
										34	10

[redacted]

TABLE XXVI. For computing the Effects of Parallax on the Moon's Distance from the Sun or a Star.

Parallax in Alt. or Dist.	Apparent Distance. Add the Difference of the two Numbers out of this Table, if the Apparent Distance is less than 90°, and subtract it if above.																			
	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	30°
M	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″
5	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
8	3	3	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1
10	5	5	4	4	4	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1
11	6	5	5	4	4	4	4	3	3	3	3	3	3	3	2	2	2	2	2	2	2
12	7	6	6	5	5	4	4	4	4	3	3	3	3	3	3	3	3	2	2	2	2
13	8	8	7	6	6	5	5	5	5	4	4	4	3	3	3	3	3	3	3	3	2
14	10	9	8	7	7	6	6	6	6	5	5	4	4	4	4	4	4	3	3	3	3
15	11	10	9	8	8	7	7	6	6	6	5	5	5	4	4	4	4	4	4	4	3
16	13	11	10	9	9	8	8	7	7	6	6	6	6	5	5	5	5	5	5	4	4
17	14	13	12	11	10	9	9	8	8	7	7	6	6	6	5	5	5	5	5	5	4
18	16	14	13	12	11	10	10	9	9	8	8	7	7	6	6	6	6	6	6	5	5
19	18	16	15	14	13	12	11	10	10	9	8	8	8	7	7	7	6	6	6	6	5
20	20	18	16	15	14	13	12	11	11	10	9	9	9	8	8	7	7	7	7	6	6
21	22	20	18	17	15	14	13	12	12	11	10	10	10	9	9	8	8	7	7	7	7
22	24	22	20	18	17	16	15	14	13	12	12	11	11	10	10	9	9	8	8	7	7
23	26	24	22	20	18	17	16	15	14	14	13	12	11	11	10	10	9	9	9	8	8
24	29	26	24	22	20	19	18	17	16	15	14	13	12	11	11	10	10	9	9	9	9
25	31	28	26	24	22	21	19	18	17	16	15	14	13	12	12	11	11	10	10	10	9
26	34	31	28	26	24	22	21	19	18	17	16	15	14	13	13	12	12	11	11	10	10
27	36	33	30	28	26	24	22	21	19	18	17	16	15	15	14	13	13	12	12	11	11
28	39	35	32	30	28	26	24	22	21	20	19	18	17	16	15	14	14	13	13	12	12
29	42	38	34	32	30	28	25	24	22	21	20	19	18	17	16	15	15	14	14	13	13
30	45	41	37	34	32	29	27	25	24	22	21	20	19	18	17	16	16	15	15	14	14
31	48	44	39	37	34	31	29	27	25	24	23	22	21	19	18	18	17	16	16	15	15
32	51	46	42	39	36	33	31	29	27	25	24	23	22	21	20	19	18	17	17	16	16
33	54	49	44	41	38	35	33	31	29	27	25	24	23	22	21	20	19	19	18	17	17
34	57	52	47	44	41	38	35	33	31	29	27	25	24	23	22	21	21	20	19	18	18
35	60	55	50	46	43	40	37	35	33	31	29	27	25	24	23	23	22	21	20	19	19
36	64	58	53	49	45	42	40	37	35	33	31	29	27	26	25	24	23	22	21	20	20
37	67	61	56	52	48	45	42	38	37	35	32	31	29	28	26	25	24	23	22	21	21
38	71	65	59	55	51	47	44	41	39	36	34	32	31	29	28	27	26	24	23	22	22
39	75	68	62	58	53	50	46	43	41	38	36	34	32	31	29	28	27	26	24	24	23
40	79	72	66	61	56	52	49	46	43	40	38	36	34	32	31	30	29	27	26	25	24
41	83	76	69	64	59	55	51	48	45	42	40	38	36	34	33	32	30	29	27	26	25
42	87	80	73	67	62	58	54	50	47	44	42	40	38	36	35	33	32	30	29	28	27
43	91	84	76	70	64	60	56	53	49	47	44	42	39	38	36	35	33	32	30	29	28
44	96	88	80	73	67	63	59	55	52	49	46	43	41	39	38	36	35	33	32	30	29
45	100	92	83	77	70	66	61	58	54	51	48	46	43	41	40	38	36	35	33	32	30
46	105	96	87	80	74	69	64	60	57	54	51	48	45	43	42	40	38	36	35	33	32
47	109	100	91	84	77	72	67	63	59	56	53	49	47	45	43	42	40	38	36	35	33
48	114	104	95	87	80	75	70	65	61	58	55	52	50	47	45	43	42	40	38	36	35
49	119	109	99	91	83	78	73	69	64	61	57	55	52	49	46	45	43	41	39	38	36
50	124	113	103	95	87	81	76	71	67	63	60	57	54	51	48	46	45	43	41	39	38
51	129	117	107	98	91	85	79	74	69	66	62	59	56	53	50	49	47	45	43	41	39
52	134	121	111	102	95	89	83	77	72	68	65	61	58	55	53	51	49	47	45	43	41
53	139	126	115	106	98	92	86	80	74	71	67	64	60	58	55	53	50	48	46	44	42
54	144	131	120	110	102	95	89	83	77	73	70	66	63	60	57	54	52	50	48	46	44
55	149	136	124	114	106	99	92	86	80	76	72	69	65	62	59	57	54	52	49	47	45
56	155	141	129	119	110	103	96	89	83	79	75	71	68	65	62	59	56	53	51	49	47
57	160	146	133	123	114	107	99	93	86	82	77	74	70	67	64	61	58	55	53	51	49
58	166	151	138	127	118	110	103	96	90	85	80	76	73	69	66	63	60	57	55	53	51
59	172	156	143	133	123	115	106	100	93	88	83	79	75	72	68	65	62	59	57	55	53
60	178	162	148	137	128	119	110	103	97	91	86	82	78	74	70	61	64	61	59	56	54
61	184	167	153	141	131	122	113	107	100	94	89	85	80	76	72	69	66	63	61	58	56
62	190	173	158	145	135	125	117	110	103	97	92	87	83	79	75	72	69	66	63	60	58

13	2	2	2	2	2	2	2	2	2	2	2	2	2	2
14	3	3	2	2	2	2	2	2	2	2	2	2	2	2
15	3	3	3	3	3	3	2	2	2	2	2	2	2	2
16	4	4	3	3	3	3	2	2	2	2	2	2	2	2
17	4	4	4	4	4	3	3	3	3	3	3	3	3	3
18	5	5	4	4	4	4	3	3	3	3	3	3	3	3
19	5	5	5	5	4	4	4	4	4	3	3	3	3	3
20	6	6	5	5	5	5	4	4	4	4	4	4	3	3
21	6	6	6	6	5	5	5	5	5	4	4	4	4	4
22	7	7	6	6	6	6	5	5	5	5	5	5	4	4
23	7	7	7	7	6	6	6	6	5	5	5	5	5	5
24	8	8	7	7	7	7	6	6	6	6	6	6	5	5
25	9	9	8	8	8	7	7	7	7	6	6	6	6	6
26	9	9	9	9	8	8	7	7	7	7	7	7	6	6
27	10	10	10	9	9	9	8	8	8	7	7	7	7	6
28	11	11	10	10	9	9	8	8	8	8	8	8	7	7
29	12	12	11	11	10	10	9	9	9	9	9	8	8	7
30	13	13	12	12	11	11	10	10	9	9	9	9	8	8
31	14	14	13	13	12	11	11	11	10	10	10	9	9	8
32	15	15	14	14	13	12	11	11	10	10	10	10	9	9
33	16	16	15	14	14	13	12	12	11	10	10	10	10	10
34	17	17	16	15	14	14	13	13	12	11	11	11	10	10
35	18	17	17	16	15	14	14	13	13	12	12	11	11	11
36	19	18	17	17	16	15	14	14	13	13	13	12	11	11
37	20	19	18	18	17	16	15	15	14	13	13	12	12	11
38	21	20	19	19	18	17	16	16	15	14	14	13	13	12
39	22	21	20	20	19	18	17	17	16	15	15	14	14	13
40	23	22	21	21	20	19	18	18	17	16	16	15	15	14
41	24	23	23	22	21	20	19	19	18	17	17	16	15	15
42	26	25	24	23	22	21	20	20	19	18	18	17	16	15
43	27	26	25	24	23	22	21	21	20	18	18	17	16	16
44	28	27	26	25	24	23	22	22	20	19	19	18	17	16
45	29	28	27	26	25	24	23	23	21	20	20	19	18	17
46	30	29	28	27	26	25	24	24	22	21	20	19	19	18
47	32	30	29	28	27	26	26	25	23	22	22	21	20	20
48	33	32	31	30	29	28	27	26	24	23	23	22	22	21

TABLE XXVI. For computing the Effects of Parallax on the Moon's Distance from the Sun or a Star.

Apparent Distance.
Add the Difference of the two Numbers taken out of this Table, if the Apparent Distance is less than 90°, and subtract it if above.

Parallax in Alt. or Dist.	52°	53°	54°	55°	56°	57°	58°	59°	120 60°	115 65°	110 70°	105 75°	100 80°	95 85°	90°	95°	100	105	110	115	120
M.	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
10	0	0	0	0	0	0	0	-0	0	0	0	0	0	0	0						
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
13	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0						
14	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0						
15	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0						
16	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0						
17	2	2	2	1	1	1	1	1	1	1	0	0	0	0	0						
18	2	2	2	2	2	2	2	2	2	1	1	0	0	0	0						
19	3	2	2	2	2	2	2	2	2	1	1	0	0	0	0						
20	3	2	2	2	2	2	2	2	2	1	1	1	0	0	0						
21	3	3	3	2	2	2	2	2	2	1	1	1	0	0	0						
22	3	3	3	3	3	3	2	2	2	2	1	1	0	0	0						
23	3	3	3	3	3	3	3	3	2	2	1	1	0	0	0						
24	4	3	3	3	3	3	3	3	3	2	1	1	1	0	0						
25	4	4	4	3	3	3	3	3	3	2	1	1	1	0	0						
26	5	4	4	4	4	4	3	3	3	3	2	1	1	0	0						
27	5	5	5	4	4	4	4	4	3	3	2	1	1	0	0						
28	6	5	5	5	5	5	4	4	4	3	2	2	1	0	0						
29	6	5	5	5	5	5	4	4	4	3	2	2	1	0	0						
30	6	5	5	5	5	5	4	4	4	4	3	2	1	0	0						
31	6	5	5	5	5	5	5	5	4	4	3	2	1	0	0						
32	6	5	5	5	5	5	5	5	5	4	3	2	1	0	0						
33	6	6	6	5	5	5	5	5	5	4	3	2	1	0	0						
34	7	6	6	6	6	6	5	5	5	4	4	2	1	0	0						
35	8	7	7	6	6	6	6	6	5	4	4	2	1	0	0						
36	8	8	7	7	7	7	6	6	6	5	4	3	2	1	0						
37	9	9	8	8	8	7	7	7	6	5	4	3	2	1	0						
38	10	10	9	9	9	8	8	7	7	5	4	3	2	1	0						
39	11	10	10	9	9	9	8	8	7	5	4	3	2	1	0						
40	11	11	10	10	9	9	8	8	8	6	5	3	2	1	0						
41	12	12	11	10	10	10	9	9	8	6	5	3	2	1	0						
42	12	12	11	11	10	10	9	9	9	7	5	4	2	1	0						
43	12	12	11	11	10	10	9	9	9	7	5	4	2	1	0						
44	12	12	11	11	11	10	10	9	9	7	6	4	2	1	0						
45	13	12	12	11	11	11	10	10	9	7	6	4	2	1	0						
46	13	13	12	12	12	11	11	10	10	8	7	5	3	1	0						
47	14	14	13	12	12	12	11	11	10	8	7	5	3	1	0						
48	15	14	13	13	12	12	12	11	11	9	7	5	3	2	0						
49	16	15	14	14	14	13	13	12	11	9	7	5	3	2	0						
50	17	16	15	15	14	13	13	12	12	10	8	6	4	2	0						
51	17	16	16	15	15	14	14	13	12	10	8	6	4	2	0						
52	17	17	16	16	15	15	14	14	13	10	8	6	4	2	0						
53	18	18	17	16	16	15	14	14	13	10	8	6	4	2	0						
54	19	18	17	17	16	16	15	15	14	11	9	7	4	2	0						
55	19	18	18	17	17	16	16	15	14	11	9	7	4	2	0						
56	20	19	18	18	17	16	16	15	15	12	9	7	5	2	0						
57	21	20	19	19	19	18	17	16	15	12	9	7	5	2	0						
58	22	21	20	20	19	18	17	16	16	13	10	7	5	2	0						
59	23	22	21	[illegible]	20	19	18	17	17	13	10	7	5	2	0						
60	24	23	22	22	21	20	19	18	18	14	11	8	5	3	0						
61	25	24	23	23	22	21	20	19	18	15	11	8	5	3	0						
62	26	25	24	23	22	21	20	19	19	16	12	9	6	3	0						
M.	52°	53°	54°	55°	56°	57°	58°	59°	60°	65°	70°	75°	80°	85°	90°						

TABLE XXVI, continued.

Par. M	95° "	100 "	105 "	110 "	115 "	120 "
5	20	20	20	20	20	20
8	20	20	20	20	20	20
10	20	20	20	20	20	20
11	20	20	20	20	20	20
12	20	20	20	20	20	20
13	20	20	20	20	20	20
14	20	20	20	20	19	19
15	20	20	20	20	19	19
16	20	20	20	20	19	19
17	20	20	20	20	19	19
18	20	20	20	19	19	18
19	20	20	20	19	19	18
20	20	20	19	19	19	18
21	20	20	19	19	19	18
22	20	20	19	19	18	18
23	20	20	19	19	18	18
24	20	19	19	19	18	17
25	20	19	19	19	18	17
26	20	19	19	18	17	17
27	20	19	19	18	17	17
28	20	19	18	18	17	16
29	20	19	18	18	17	16
30	20	19	18	17	16	16
31	20	19	18	17	16	16
32	20	19	18	17	16	15
33	20	19	18	17	16	15
34	20	19	18	16	16	15
35	20	19	18	16	16	15
36	19	18	17	16	15	14
37	19	18	17	16	15	14
38	19	18	17	16	15	13
39	19	18	17	16	15	13
40	19	18	17	15	14	12
41	19	18	17	15	14	12
42	19	18	16	15	13	11
43	19	18	16	15	13	11
44	19	18	16	14	13	11
45	19	18	16	14	13	11
46	19	17	15	13	12	10
47	19	17	15	13	12	10
48	18	17	15	13	11	9
49	18	17	15	13	11	9
50	18	16	14	12	10	8
51	18	16	14	12	10	8
52	18	16	14	12	10	7
53	18	16	14	12	10	7
54	18	16	13	11	9	6
55	18	16	13	11	9	6
56	18	15	13	11	8	5
57	18	15	13	11	8	5
58	18	15	13	10	7	4
59	18	15	13	10	7	3
60	17	15	12	9	6	2
61	17	15	12	9	5	2
62	17	14	11	8	4	1
M	95°	100°	105	110	115	120

TABLE XXVII. For reducing Minutes into Seconds, and the contrary.

Sec.	Min 0	Min 1	Min 2	Min 3	Min 4	Min 5	Min 6	Min 7	Min 8	Min 9	Min 10	Min 11	Min 12
1	1	61	121	181	241	301	361	421	481	541	601	661	721
2	2	62	122	182	242	302	362	422	482	542	602	662	722
3	3	63	123	183	243	303	363	423	483	543	603	663	723
4	4	64	124	184	244	304	364	424	484	544	604	664	724
5	5	65	125	185	245	305	365	425	485	545	605	665	725
6	6	66	126	186	246	306	366	426	486	546	606	666	726
7	7	67	127	187	247	307	367	427	487	547	607	667	727
8	8	68	128	188	248	308	368	428	488	548	608	668	728
9	9	69	129	189	249	309	369	429	489	549	609	669	729
10	10	70	130	190	250	310	370	430	490	550	610	670	730
11	11	71	131	191	251	311	371	431	491	551	611	671	731
12	12	72	132	192	252	312	372	432	492	552	612	672	732
13	13	73	133	193	253	313	373	433	493	553	613	673	733
14	14	74	134	194	254	314	374	434	494	554	614	674	734
15	15	75	135	195	255	315	375	435	495	555	615	675	735
16	16	76	136	196	256	316	376	436	496	556	616	676	736
17	17	77	137	197	257	317	377	437	497	557	617	677	737
18	18	78	138	198	258	318	378	438	498	558	618	678	738
19	19	79	139	199	259	319	379	439	499	559	619	679	739
20	20	80	140	200	260	320	380	440	500	560	620	680	740
21	21	81	141	201	261	321	381	441	501	561	621	681	741
22	22	82	142	202	262	322	382	442	502	562	622	682	742
23	23	83	143	203	263	323	383	443	503	563	623	683	743
24	24	84	144	204	264	324	384	444	504	564	624	684	744
25	25	85	145	205	265	325	385	445	505	565	625	685	745
26	26	86	146	206	266	326	386	446	506	566	626	686	746
27	27	87	147	207	267	327	387	447	507	567	627	687	747
28	28	88	148	208	268	328	388	448	508	568	628	688	748
29	29	89	149	209	269	329	389	449	509	569	629	689	749
30	30	90	150	210	270	330	390	450	510	570	630	690	750
31	31	91	151	211	271	331	391	451	511	571	631	691	751
32	32	92	152	212	272	332	392	452	512	572	632	692	752
33	33	93	153	213	273	333	393	453	513	573	633	693	753
34	34	94	154	214	274	334	394	454	514	574	634	694	754
35	35	95	155	215	275	335	395	455	515	575	635	695	755
36	36	96	156	216	276	336	396	456	516	576	636	696	756
37	37	97	157	217	277	337	397	457	517	577	637	697	757
38	38	98	158	218	278	338	398	458	518	578	638	698	758
39	39	99	159	219	279	339	399	459	519	579	639	699	759
40	40	100	160	220	280	340	400	460	520	580	640	700	760
41	41	101	161	221	281	341	401	461	521	581	641	701	761
42	42	102	162	222	282	342	402	462	522	582	642	702	762
43	43	103	163	223	283	343	403	463	523	583	643	703	763
44	44	104	164	224	284	344	404	464	524	584	644	704	764
45	45	105	165	225	285	345	405	465	525	585	645	705	765
46	46	106	166	226	286	346	406	466	526	586	646	706	766
47	47	107	167	227	287	347	407	467	527	587	647	707	767
48	48	108	168	228	288	348	408	468	528	588	648	708	768
49	49	109	169	229	289	349	409	469	529	589	649	709	769
50	50	110	170	230	290	350	410	470	530	590	650	710	770
51	51	111	171	231	291	351	411	471	531	591	651	711	771
52	52	112	172	232	292	352	412	472	532	592	652	712	772
53	53	113	173	233	293	353	413	473	533	593	653	713	773
54	54	114	174	234	294	354	414	474	534	594	654	714	774
55	55	115	175	235	295	355	415	475	535	595	655	715	775
56	56	116	176	236	296	356	416	476	536	596	656	716	776
57	57	117	177	237	297	357	417	477	537	597	657	717	777
58	58	118	178	238	298	358	418	478	538	598	658	718	778
59	59	119	179	239	299	359	419	479	[illegible]	599	659	719	779
60	60	120	180	240	300	360	420	480	540	600	660	720	780

LATITUDES AND LONGITUDES

OF

THE PRINCIPAL PORTS, HARBOURS, CAPES, SHOALS, ROCKS, &c.

IN

THE WORLD;

Deduced from the Observations of the most celebrated Navigators and Astronomers; compared with the latest and most accurate Charts, Maps, &c.

The Longitudes are reckoned from the Meridian of Greenwich.

COASTS OF GREAT BRITAIN, AND ISLANDS ADJACENT.

South Coast of England.

Names of Places.	Latitude.			Longitude.		
	D.	M.	S.	D.	M.	S.
LONDON (St. Paul's)	51	30	49N.	0	5	47W.
Greenwich Obs.	51	28	40	0	0	0
Nore	51	28	0	0	46	0E.
North Foreland Light	51	22	40	1	26	22
Deal Castle	51	13	5	1	23	59
S. Foreland Light-h.	51	8	26	1	22	6
Dover Castle	51	7	47	1	19	7
Dungeness Light-h.	50	55	1	0	57	48
Hastings..........	50	52	0	0	35	0
Beachy Head	50	44	23	0	15	12
Seaford	50	47	20	0	7	0
Brighton Church ..	50	49	32	0	11	55W.
Shoreham	50	49	59	0	16	19
Arundel	50	49	0	0	35	15
Owers Light	50	39	57	0	39	15
Selsey Bill	50	44	5	0	48	0
Portsmouth Church	50	47	26	1	5	57

Isle of Wight.

Names of Places.	Latitude.			Longitude.		
	D.	M.	S.	D.	M.	S.
Bembridge Point ..	50	40	59N.	1	4	25 W.
Princessa Shoal, S. B.	50	39	30	1	4	25
Dunnose Point	50	37	7	1	11	36
St. Catherine's Tower	50	35	33	1	17	51
Needles Light	50	39	53	1	33	55
Cowes..............	50	45	37	1	16	15
Hurst Light-house .	50	42	23	1	32	50
Christ Church Head	54	43	37	1	45	10
Branksea Cast. (Pool)	50	41	19	1	57	1
St. Alban's Head ..	50	33	30	2	2	0
Weymouth..........	50	36	15	2	26	40
Shambles Shoal, Mid.	50	32	0	2	22	0
Portland Uplight ..	50	31	32	2	26	50
Lyme Cob	50	43	10	2	55	29
Berry Head, F. S.	50	24	0	3	28	14
Dartmouth..........	50	22	0	3	34	0
Start Point, F. S. ..	50	13	26	[illegible]	36	21
Bolt Head, F. S. ..	50	13	15	3	48	3
Rame Head	50	18	52	4	12	29
Plymouth Old Ch.	50	22	13	4	7	32
Eddystone Light-h.	50	10	54	4	15	2
Deadman's Pt. F. S.	50	13	20	4	47	8
Pendennis Castle....	50	8	49	5	1	44

Names of Places.	Latitude.			Longitude.		
	D.	M.	S.	D.	M.	S.
Blackhead, F. S. ..	50	1	12N.	5	4	0W.
Lizard Point	49	57	40	5	11	46
Mount's B. (Penz.)	50	7	40	5	31	0
Runnel Stone	50	1	20	5	39	0
Wolf Rock	49	57	20	5	47	45
Land's End (Stone)	50	4	7	5	41	32
Longships Light-h.	50	4	20	5	44	30
St. Martin's Day-mark	49	58	39	6	14	39
St. Agnes Light-h.	49	53	27	6	19	23
Seven Stones	50	6	20	5	47	20

West Coast of England.

Names of Places.	Latitude.			Longitude.		
	D.	M.	S.	D.	M.	S.
Cape Cornwall	50	7	50N.	5	42	0W.
St. Ives Point	50	13	20	5	26	0
Cow and Calf	50	32	45	5	2	22
Port Isaac	50	36	0	4	16	0
Hartland Point	51	1	0	4	25	0
Barnstable	50	7	20	4	3	0
Mort Pt. South Entrance of Bristol Channel	51	12	0	4	7	0
Lundy Island	51	9	48	4	28	33
Flatholm Light-house	51	23	0	3	0	0
*Bristol	51	27	6	2	35	29
Ness Point	51	29	30	3	31	50
Mumble's Light....	51	36	45	3	55	0
Worm's Head......	51	35	25	4	13	0
Caldy Island	51	44	20	4	26	30
St. Gowan's Point ..	51	40	10	4	47	0
St. Ann's Lights ..	51	40	45	5	1	0
Small's Light-house	51	45	40	5	28	0
Hatts and Barrels	51	45	15	5	20	15
St. David's Head ..	51	55	0	5	8	0
Strumble's Head ..	52	1	18	5	0	0
Dinas Point	52	1	10	4	50	0
Cardigan Island	52	7	45	4	39	0
New Key Head	52	10	40	4	19	0
Aberistwith........	52	21	20	3	59	0
Aberdovey	52	33	0	4	0	0
Barmouth	52	43	30	4	0	0
Penkellan Head	52	47	30	4	32	0
Bardsey Island So. Pt.	52	44	30	4	46	30
Porthdinlleyn Head	52	55	30	4	34	0

TABLE XXVIII. Of Latitudes and Longitudes.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Holyhead Isl. W. P.	53	18	45N.	4	40	30W.
Skerries Light-house	53	24	50	4	36	30
Point Linas Light ..	53	24	30	4	17	45
Great Orms Head ..	53	20	0	3	50	20
Point of Ayr Light-h.	53	21	0	3	16	0
Lake Lights	53	23	0	3	8	0
Liverpool	53	23	30	2	57	0
Formby Point......	53	35	45	3	5	0
Lancaster	54	3	0	2	51	0
Selker Rock	54	16	30	3	57	0
St. Bees Head Lighth.	54	30	15	3	42	15
Whitehaven	54	32	30	3	34	45
Workington	54	38	0	3	30	0
Mary Port	54	43	0	3	27	0
Carlisle	54	55	45	2	55	30
Isle of Man.						
Calf of Man	54	2	0N.	4	50	0W.
Point of Air	54	24	30	4	22	30
Ramsey	54	19	30	4	26	0
Douglas	54	8	30	4	30	0
West and North Coast of Scotland.						
Ross	54	46	30N.	4	8	0W.
Burrow Head	54	41	30	4	27	0
Great Scar Island ..	54	40	30	4	46	0
Mull of Galloway ..	54	37	45	4	56	0
Port Patrick Light-h.	54	48	0	5	8	0
Elsa Island	55	16	15	5	12	8
Air Light-house	55	26	30	4	44	0
Pladda Island Lights	55	27	0	5	11	0
North Point Arran Isl.	55	40	0	5	20	0
Cumry Island Light	55	46	20	5	16	0
Greenock	55	58	0	5	6	0
M. of Cantire Lighth.	55	18	30	6	0	0
Gia Island, North End	55	45	0	6	1	0
Run's Point, Ila Isl.	55	47	0	6	44	0
Touvore Head, Ditto	55	54	0	6	45	0
Skerryvore Rocks ..	56	15	45	7	24	0
Duskier Rock......	56	34	0	7	20	0
Tire-ey Isle, N. W. P.	56	33	0	7	16	0
Helsker Islands	56	56	0	6	59	0
Sunk Rocks, to the westward of Helsker	56	55	0	7	8	0
Coll Island, East End	56	41	0	6	48	0
Rum Island, East End	57	0	0	6	30	0
Cana Island, East Pt.	57	3	0	6	44	0
Dounegan Head....	57	30	0	7	4	0
Valernish Point	57	35	20	6	54	0
Rea Head	57	50	0	6	2	0
Moge Head........	58	4	40	5	29	0
Stower Head	58	13	30	5	37	0
Cape Wrath	58	36	0	5	19	0
Rona Island	58	54	45	6	16	0
Bara, or Suliaker Isl.	58	54	0	6	28	0
Far-out Head	58	39	0	4	55	0
Dunnet Head	58	42	0	3	27	0
Duncansby Head ..	58	40	0	3	8	0
Lewis Islands.						
Bernera Island	56	48	0N.	7	56	0W.
Grien Head, Bara Isl.	57	0	0	7	53	0
Ruardvula, So. Uist I.	57	12	0	7	49	0
Hyskere Island, W. P.	57	28	30	8	0	0
Casamul Island	57	34	20	8	0	0
Rennish Head	57	41	0	7	16	0
Toe Head	57	49	30	7	25	0
Glash Island Light..	57	50	0	6	56	0
Gallen Head	58	10	30	7	24	0
Flannen Isles......	58	14	0	7	51	0
St. Kilda Isle......	57	50	0	8	18	0
Aird Point	58	15	0	6	24	0
*But of the Lewis ..	58	28	30	6	34	0
The Orkney Islands.						
Pentland Skerries ..	58	42	30N.	3	2	0W.
Stroma Island, S. End	58	43	0	3	14	0
South Ronoldsha, S.P.	58	45	0	3	4	0
Copinshaw	58	56	0	3	46	0
Stronsa Isl. Lamb H.	59	6	30	2	28	0
Tressness, Sanda Isle	59	15	30			
Start,...... Ditto..	59	19	0			
North Ronoldsha Lt.	59	25	30	2	36	0
Mould Head, Pappa Westra Island..	59	23	0	3	1	0
Noup Head, Westra Isle..........	59	20	30	3	9	0
Marwick H. Pomona I.	59	6	0	3	22	0
Stromness, Pomona Ilse	58	58	30	3	28	0
Hoyhead Head, Hoywalls Island ..	58	57	0	3	22	0
The Stack	59	2	0			
Sule Skerry	59	3	10			
Fair Island	59	29	30	1	45	0
Shetland Isles.						
Suenburgh Head....	59	52	0N.	1	28	0W.
Hang Cliff	60	7	0	0	50	0
Brassa Sound, Lerwick	60	10	0	0	52	0
Whalsey Island	60	25	0	0	39	0
Unst Island, N. E. Pt.	60	42	30	0	0	0
Foul Island	60	25	0	1	20	0
Ferro Isles.						
Monk Rock, which appears like a Sail	61	18	0N.	6	41	0W.
Fulae Island	62	14	30	6	10	0
Myggeness Island, E.P.	62	4	30	7	28	0
East Coast of Scotland and England.						
Noss Head	58	32	30N.	3	8	0W.
Clythness	58	2[illegible]	[illegible]	3	15	0
Ord Head	58	12	30	3	37	0
Tarbet Ness	57	53	45	3	43	0

TABLE XXVIII. Of Latitudes and Longitudes.

Names of Places.	Latitude.			Longitude.		
	D.	M.	S.	D.	M.	S.
Cromarty	57	42	30N.	4	1	0W.
Inverness	57	32	0	4	8	0
Fort George	57	38	0	4	6	0
Brugh Head	57	44	30	3	31	0
Kennaird's Head Lt.	57	39	30	2	1	0
Peter Head.........	57	32	0	1	47	0
Buchan Ness	57	29	30	1	47	0
New Aberdeen	57	9	0	2	9	0
Montrose	56	12	45	2	29	0
Red Head	56	37	30	2	32	0
Arbroath...........	56	34	30	2	38	0
Bell Rocks Light ..	56	26	30	2	27	0
Buttoness Lights ..	56	29	15	2	46	0
Dundee	56	29	0	2	59	0
St. Andrew's	56	21	0	2	50	0
Fife Ness	56	17	0	2	38	0
No. Carr Rock	56	16	0	2	37	0
May Island Light ..	56	11	15	2	39	0
EDINBURGH	55	57	15	3	13	0
The Bass	56	6	0	2	42	0
Dunbar	56	1	30	2	34	0
St. Abbs Heads	55	56	0	2	11	0
Berwick	55	48	30	2	6	0
Rocky Bank, Mid. ..	56	11	0	2	11	0
Holy Island, N. E. P.	55	43	30	1	53	0
Bamburgh Castle ..	55	39	0	1	48	0
Staple's Light	55	40	0	1	43	0
Fern Island Light ..	55	38	0	1	45	0
Coquet Island	55	22	30	1	30	0
Tinmouth Light....	55	4	0	1	20	0
Hartlepool	54	44	30	1	7	0
Stockton...........	54	36	0	1	18	0
Whitby	54	28	30	0	50	0
Scarborough	54	20	0	0	23	0
Filey Brig	54	16	30	0	11	0
Flamborough Head	54	7	0	0	6	0
Spurn Lights.......	53	39	0	0	24	0E.
Outer Dowsings, N. W. end	53	44	30	1	13	0
Haddock Bank	53	46	0	1	39	0
Shoal to the Westward of Outer Dowsing	53	44	0	1	35	0
Dudgeon Lights....	53	30	0	1	7	0
Inner Dowsing	53	20	30	0	42	0
Cromer Bank.......	53	25	0	1	34	0
Lemon and Owers, M.	53	21	0	1	58	0
Sherringham Shoal	53	9	30	2	2	0
Hasborough Sand S. Buoy	53	0	0	1	53	0
Hammond's Knowl	52	58	0	1	59	0
Smith's Knowl, Buoy	52	59	0	2	26	0
The Ridge	53	0	0	2	43	0
Cromer Lights	53	6	0	1	26	0
Yarmouth	52	37	0	1	44	0
Leostoff Lights	52	29	20	1	46	30
Southwold	52	20	0	1	42	35
Albro' Napes	52	9	0	1	43	0
Orfordness	52	5	0	1	34	14
Kentish Knock	51	42	30	1	36	30

West Coast of Ireland.

Names of Places.	Latitude.			Longitude.		
	D.	M.	S.	D.	M.	S.
Cape Clear	51	22	30N.	9	30	0W.
Fastnet Rock	51	19	30	9	34	0
Crookhaven	51	28	30	9	41	40
Mizen Head	51	27	0N.	9	47	0W.
Bantry B. Sheep's H.	51	34	0	9	49	0
Grelagh Rocks	51	31	30	10	8	0
Dursey Isle, W. End	51	36	0	10	12	0
Bull Rock	51	37	0	10	16	0
Cod's Head.........	51	42	0	10	5	0
Hog Islands	51	47	0	10	14	0
Bolus Head	51	50	45	10	18	45
Skelling's Rock	51	50	0	10	31	0
Lemon Rock	51	52	0	10	25	0
—Bray Head	51	57	0	10	24	0
—Dunmore Head ..	52	10	0	10	24	0
Foze Rock	52	5	0	10	37	0
Ferriter's Island	52	7	0	10	32	0
Tiraght Rocks	52	8	30	10	35	0
Great Blasket, W. End	52	8	30	10	29	0
Ennis Tuskar	52	12	30	10	30	0
Dunorling Head....	52	17	0	10	19	30
Brandon Head	52	22	0	10	8	0
—Kerry Head......	52	30	0	9	54	0
—Loop Head Light	52	37	0	9	54	0
Limerick	52	42	0	8	42	0
Ballards Point	52	42	30	9	34	0
Hags Head	52	55	0	9	42	0
—Black Head.......	53	6	30	9	28	0
—Galway	53	15	0	9	11	0
N. Arran Isle, W. End	53	7	0	10	3	0
Skird Rocks	53	16	0	10	18	0
Sline Head	53	25	30	10	29	0
Shark Isle	53	36	45	10	36	0
Ennis Turk Island ..	53	42	0	10	24	0
Clare Island, W. End	53	46	15	10	18	0
Achill Head	53	58	30	10	30	0
Black Rock.........	54	5	0	10	35	0
Urris Head.........	54	20	30	10	13	0

North Coast of Ireland.

Names of Places.	Latitude.			Longitude.		
	D.	M.	S.	D.	M.	S.
Kid Isles	54	22	0N.	10	8	0W.
Three Turn Rocks ..	54	23	30	10	4	0
Down Patrick Head	54	21	0	9	36	0
Killala	54	13	30	9	27	0
Sligo	54	16	45	8	31	0
Wheaten Rock	54	21	35	8	55	0
Donnegal	54	38	30	8	14	0
Tellen Head	54	41	30	8	55	0
Douras Head	54	51	0	8	42	0
Arranmore I. N. End	55	5	45	8	36	0
Bloody Foreland....	55	10	30	8	17	0
Tory Island.........	55	17	45	8	11	0
Horn Head.........	55	14	0	7	57	0
Mull Oy...........	55	17	0			
Bucan's Head......	55	17	45	7	47	0
—Dunaff Head	55	17	30	7	32	0
Mullin Head	55	24	0	7	24	0
Ennistrahul Rocks ..	55	29	15	7	11	0
Colodah Head	55	22	0	7	7	0
Inishone Head	55	15	45	6	51	0
Londonderry	55	1	0	7	16	0
Giant's Causeway ..	55	17	30	6	30	0
Rachlin I. W. End	55	21	15	6	8	0
Fair Head	55	14	45	6	4	0
Tor Head	55	13	30	6	1	0

ast of Ireland.

Latitude. D.	M.	S.	Longitude. D.	M.	S.
54	57	20N.	5	37	0W.
54	46	30	5	35	0
54	42	20	5	45	0
54	34	30	5	56	0
54	40	45	5	23	0
54	20	50	5	22	0
54	13	15	5	50	0
54	5	30	6	12	0
53	58	30	6	16	0
53	49	30	6	20	0
53	44	0	6	14	0
53	35	20	5	57	0
53	30	0	5	56	0
53	22	30	6	3	0
53	21	42	6	15	0
52	59	0	6	1	0
52	50	0	6	7	0
52	39	15	6	10	0
52	22	30	6	17	0

oast of Ireland.

Latitude. D.	M.	S.	Longitude. D.	M.	S.
52	12	30N.	6	7	0W.
52	14	0	5	58	0
52	6	0	6	23	0
52	4	30	6	45	0
52	13	0	7	59	0
52	7	0	6	59	0

Cattegat and Sound.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Paternosters	57	55	0N.	11	27	0 E.
Marstrand Light ..	57	54	0	11	35	0
Wingo Beacon	57	38	45	11	37	0
Gothenburgh	57	42	30	11	59	0
Lessiou I. East Point	57	18	45	11	10	0
———West Point	57	15	0	10	50	0
Trindel Rock	57	19	0	11	7	0
Grasholm	57	29	0	10	36	0
Suitringen Shoal ..	57	0	0	10	29	0
Niddingen Lights ..	57	18	0	11	55	0
Warberg..........	57	6	30	12	16	0
Rocky Shoal, Little M. Ground....	56	57	20	12	0	0
Falkenburgh	56	54	20	12	29	0
Halmsted	56	40	30	12	52	0
Anholt Light	56	45	0	11	40	0
Knobbin..........	56	45	0	11	53	0
Waderoe I. West P.	56	28	0	12	33	0
Koll Light	56	19	20	12	27	47
Lysle Ground	56	19	0	11	48	0
Hisell Island	56	12	0	11	42	0
Stains Head	56	35	20	10	51	0
Granan	56	25	0	10	55	0
Chalk Ground, Shoal	56	25	0	11	52	0
Navaren Shoal	56	23	30	11	0	0
Jesness Ground, Shoal	56	17	0	10	53	0
HasteusGround, Ditto	56	15	0	11	10	0
Nackehovet Lights	56	6	30	12	21	0
Cronenburgh Light	56	3	20	12	37	0

Gulf of Finland.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Abo	60	27	7N.	22	18	30E.
Dagerort Point	58	57	30	22	1	0
Odenholm Islands ..	59	19	0	23	21	0
Hango Island and Lt.	59	49	0	23	20	0
Packerort Light	59	24	30	24	5	0
Surp Point and Light	59	28	10	24	28	0
Kasch Skar Light	59	38	20	25	9	0
Hoogland Isl. N. End	59	58	0	27	7	0
See Skar Isl. N. End	59	56	25	28	30	0
Wyburgh	60	40	0	29	55	0
Tol, Beacon Light ..	60	1	0	29	40	0
Cronstad	59	57	40	29	54	0
PETERSBURGH	59	58	40	30	20	0

The Coast of Norway and Lapland, from Christiana to Archangel.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Christiana	59	52	45N.	10	52	E.
Frederickstad	59	10	15	11	2	0
Stromstad	58	55	10	11	13	0
Faerder Light	59	2	35	10	49	0
Arundal	58	40	0	8	57	0
Christiansand	58	19	0	8	14	0
Naze	58	7	20	7	15	0
Walbert's Head	58	32	0	5	56	0
Bommel Head	59	31	30	5	0	0
Ulster's Islands	59	24	0	4	50	0
Bergen	60	14	0	5	11	0
Ronde Light	62	22	0	5	40	0
Drontheim	63	26	30	10	20	0
Werro Island	67	40	0	11	26	0
North Cape	71	9	45	26	1	0
North Kyne Cape ..	71	6	10	27	44	0
Wardhur's Island ..	70	30	30	30	40	0
Oister Haven, Fisher's Island	70	3	0	31	41	0
Terrybem Point ...	69	10	20	33	58	0
Nagle Island, N. Point	68	33	12	35	40	0
Cape Sweetnose ...	67	58	45	37	30	0
Lambachoe Point ..	67	34	30	38	30	0
Cape Orlogenose ..	67	1	35	40	21	0
Cross Island, N. Point	66	21	0	38	45	0
Onega	63	36	0	37	20	0
Cape Donega	64	45	20	35	42	0
Archangel	64	33	30	38	59	0
Blue Point	65	19	20	38	5	0
Cape Bona Fortuna	66	21	10	40	24	0
Morsham Island, M.	66	39	20	40	40	0
Cape Candinose ...	68	22	30	41	25	0
Nova Zembla	78	6	0	76	20	0

The Coast of Greenland.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
John Mayen's Island	71	10	25N.	9	50	0W.
Gael Hamkes Bay ..	75	0	40	6	51	0
Bontoise Island ..	73	27	20	9	36	0
Charn Point..	70	5	15	22	24	0
Dangy Island	67	23	10	27	25	0
Herjoiss Ness	65	3	0	30	25	0
Whales Island	62	30	5	39	9	0
Cape Discord	60	51	0	40	0	0
Cape Prince Christian	59	55	45	41	35	0
Cape Farewel	59	38	30	42	44	0
Cape Desolation ..	62	0	9	46	12	0

The Coast of Iceland.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Reikianess Cape ..	63	55	10N.	22	45	0W.
Westman's Island ..	63	2	25	21	9	0
Patrixford	65	36	6	24	9	0
Straumness	65	40	14	21	30	0
North Cape	66	34	20	23	10	0
Grims Island	67	0	30	21	46	0
Rikefiord	67	0	15	17	35	0
Longnose	66	45	10	12	19	0
Blaaness	66	2	15	12	21	0
Enchuisen Island ..	65	0	25	10	5	0
Engellcoast	64	32	10	12	19	0
Wreeland Island ...	64	5	5	13	19	0
Cape Hekla	63	22	20	16	54	0

Davis's Straits.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Cape Resolution ...	62	40	40N.	46	43	0W.
Cape Comfort	62	45	45	47	35	0
Hope Harbour	64	55	0	47	55	0
Gilbert's Sound ...	64	15	20	47	58	0
Cooken Sound	64	50	16	48	3	0
K. Christian River ..	66	7	25	47	13	0
Musketo Cove	64	55	30	52	56	0
Romel Fort	67	22	15	45	58	0
Disco. I. S. W. Point	69	6	45	14	43	0
Waygate Island ...	70	40	30	14	14	0
James I. C. Bedford	68	30	0	50	12	0
Cumberld. I. S. Point	66	0	12	60	35	0
Bay of Good Fortune	64	20	25	61	34	0
Resolution Island ..	62	5	15	64	35	0
Cape Warwick ...	61	4	0	61	35	0

Coast of France, Spain, and Portugal, from Calais to Gibraltar.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Calais	50	57	30N.	1	50	56E.
Cape Grisness	50	52	30	1	35	30
Boulogne	50	43	40	1	36	30
Etaples	50	31	0	1	38	0
St. Val. sur Somme	50	11	0	1	38	0
Dieppe	49	55	15	1	4	30
St. Valery in Caux ..	49	52	30	0	4	0
Fecamp	49	46	0	0	22	10
Cape de Caux	49	42	40	0	11	0
Cape de la Heve Lt.	49	30	30	0	4	10
Havre	49	29	15	0	6	0
Honfleur	49	25	10	0	13	59
PARIS	48	51	15	2	20	15
Point de Conchar ...	49	22	30	0	31	30 W
Point de la Percée ..	49	23	25	0	56	0
St. Marcou Island	49	29	49	1	8	50
Cape Barfleur Light	49	41	45	1	16	30
Cherbourg	49	38	29	1	37	30
Cape la Hague	49	43	33	1	55	30
Alderney Isl. N. End	49	45	0	2	10	50
Casket Lights	49	45	0	2	25	50
Guernsey I. S. Pierre	49	29	0	2	33	0
Sark I. Windmill ..	49	23	32	2	24	45
Jersey I. Cape Grisness	49	15	15	2	14	0
—St. Aubin	49	10	30	2	10	30

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Corbier	49	10	45N.	2	15	0W.
Chosey Island, Middle	48	52	20	1	49	10
Coutances	49	2	50	1	26	35
St. Margaret	48	56	10	1	32	30
Granville Light	48	50	13	1	36	4
Avranches	48	41	18	1	21	50
Mount St. Michael	48	38	14	1	30	39
St. Malo	48	39	1	2	1	14
Tower de la Conche	48	41	4	2	2	40
Cape Frehel Light	48	41	5	2	18	47
St. Brieux	48	31	0	2	42	30
Brehat Isl. North End	48	51	20	2	55	45
Rock Douver, Mid.	49	5	20	2	53	0
Seven Island, Middle	48	55	0	3	24	0
Triangle Rocks, E. End	48	54	0	3	36	0
Rock Blanch	49	1	30	3	56	50
Isle of Bas, N. End	48	45	40	4	0	0
Le Four Isle	48	36	0	4	45	30
Ushant Light	48	28	38	5	2	36
Point Matthews	48	19	24	4	45	39
Brest	48	22	42	4	28	59
Point Raz	48	4	0	4	45	0
Saints Rocks	48	5	0	5	3	15
Point l'Abbe	47	48	40	4	23	0
Glenan Islands	47	42	0	4	0	0
Quimperlay	47	51	53	3	33	0
L'Orient	47	44	30	3	22	0
Quiberon, S. Point	47	28	0	3	4	0
Isle de Groas, E. Pt.	47	37	0	3	24	0
Belle Isle, N. End	47	22	50	3	14	55
Houat Island, Middle	47	23	0	2	57	42
Hedic Island	47	20	45	2	51	5
Isle de Djeu, N.W. End	46	43	0	2	24	0
Auray	47	40	4	2	58	26
Vannes	47	39	24	2	45	19
Croisic	47	17	9	2	28	30
Nantes	47	12	45	1	32	45
Noirmoustier I. N. End	47	2	0	2	17	20
St. Gilles	46	41	30	1	56	0
Roche Bon	46	16	0	2	24	0
Isle of Rhee, Light	46	14	49	1	33	15
Isle of Oleron, N. P.	46	3	0	1	24	45
Cordovan Light	45	35	19	1	9	45
Royan	45	3	0	1	2	0
Bourdeaux	44	50	20	0	34	0
C. Feret	44	40	0	1	16	30
C. Breton	43	39	0	1	25	0
Bayonne	43	29	25	1	29	12
St. Jean de Luz	43	23	15	1	39	40
C. Machicaco	43	29	0	2	40	0
Bilboa	43	15	20	2	43	0
C. Mayor	43	30	0	3	38	0
St. Vincent	43	23	0	4	15	0
Villaviciosa	43	34	0	5	20	0
Gijon	43	35	0	5	38	0
C. Penas	43	43	0	5	48	0
Aviles	43	35	0	5	53	0
Rebadeo	43	33	10	7	2	0
C. Ortegal	43	46	37	7	51	0
Ferrol	40	29	0	8	15	45
C. Finisterre	42	50	0	9	16	15
C. Corubedo	42	39	0	9	10	30
Vigo	42	14	0	8	39	45
Vienna	41	47	0	8	43	0
Oporto	41	9	0	8	46	0
C. Mondego	40	10	50	8	52	0

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
C. Fesaraon	39	31	0N.	9	4	0W.
Burlings	39	28	0	9	23	0
Lisbon Rock (Cape)	38	45	15	9	26	0
Lisbon	38	42	0	9	7	0
C. Spichel	38	25	0	9	10	0
St. Ubes	38	31	0	8	42	0
Sines	37	55	0	8	46	0
C. St. Vincent	37	2	30	9	1	30
Lagos	37	8	30	8	39	0
C. St. Mary	36	56	0	7	51	0
Pt. des Humbria	37	5	45	7	3	0
Pt. Avenilla	37	5	6	6	57	0
St. Lucar	36	45	0	6	16	30
Seville	36	59	0	5	58	0
Cadiz	36	32	0	6	17	15
C. Trefalgar	36	10	15	6	1	15
Gibraltar, Europa Pt.	36	6	30	5	20	46

North Coast of the Mediterranean.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Malaga	36	43	30N.	4	25	15W.
Modrill	36	44	50	0	32	0
Almeria	36	51	0	2	31	0
C. de Gatt	36	43	50	2	14	5
Point Cape	37	25	20	1	28	20
Carthagena	37	35	50	1	1	15
Cape Pallas	37	37	15	0	42	15
Alicant	38	20	41	0	29	50
C. St. Martin	38	47	20	0	9	5E.
Denia	38	52	20	0	5	0
Valencia	39	26	0	0	18	15W.
C. Oropesa	40	5	30	0	7	10E.
River Ebro, Entrance	40	43	0	0	55	0
C. Salo	41	4	30	1	10	35
Terragona	41	8	50	1	17	0
Barcelona	41	23	8	2	10	45
C. St. Sebastian	41	53	50	3	8	15
Bay of Roses	42	14	0	3	11	0
Cape Creux	42	19	35	3	15	55
Collioure	42	31	45	3	5	0
Perpignan	42	41	59	2	53	35
Narbonne	43	10	58	2	59	59
Agde	43	18	40	3	28	0
Fort Breqon	43	15	38	3	30	3
Cette Lights	43	23	50	3	41	46
Montpelier	43	26	29	3	52	25
Aigues Light	43	32	30	4	11	0
Tour de Bouc	43	22	30	4	58	34
Marseilles	43	17	50	5	21	43
La Ciotat	43	10	20	5	41	0
Toulon	43	7	16	5	55	31
Hieres	43	7	45	6	8	0
Gien	43	2	30	6	7	0
C. Taillar	43	8	0	6	44	0
Frejus	43	25	49	6	43	52
St. Tropez	43	16	27	6	39	20
C. Gros	43	39	0	7	9	0
Cannes	43	33	50	7	0	16
Antibes	43	34	40	7	7	10
St. Marguerite, Island	43	31	20	7	4	0
Nice	43	41	47	7	16	22
Villa Franche Light	43	40	20	7	19	15
Cape Melle	43	58	0	8	21	0
Savona	44	17	20	8	26	0
Genoa	44	24	50	8	55	0

TABLE XXVIII. Of Latitudes and Longitudes.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Rappallo	44	20	0N.	9	17	0E.
Point Venere	14	2	0	9	40	0
Pisa	43	43	0	10	23	0
Florence	43	46	35	11	15	0
Leghorn	43	33	0	10	16	30
C. Mount Nero	43	24	0	10	23	0
Vada	43	19	0	10	37	0
Cape Troy	42	49	0	10	44	0
Point Hercole	42	24	10	11	12	0
Civita Vecchia	12	6	0	11	46	0
Rome	41	53	54	12	27	41
Cape d'Anzia	41	24	0	12	37	0
Cercello Point	41	12	0	13	5	0
Gaeta	41	12	0	13	31	0
Naples	40	50	15	14	17	30
Salerno	40	42	0	14	46	0
Policastro	10	4	0	15	46	0
Cape Vatican	38	36	0	16	8	0
Cape Scylla	38	14	0	16	3	0
Cape del Arme	37	56	0	15	59	0
Cape Spartevento	37	53	0	16	25	0
Cape Colonne	39	3	0	17	38	0
Cape Lizza	39	18	30	17	32	0
Taranto	40	16	0	17	38	0
Cape St. Mary	39	40	0	18	53	0
Cape Otranto	40	5	0	19	5	0
Brindisi	40	40	0	18	3	0
Manfredonia	41	39	0	16	17	0
Ortona	42	36	0	14	52	0
Ancona	43	37	54	13	28	52
Comachio	44	25	0	12	3	0
Chiozza	45	15	0	12	4	0
Venice	45	40	0	12	21	0
Trieste	45	49	0	13	53	0
Rovigno	45	12	0	13	49	0
Segnia	45	11	0	15	19	0
Zara	44	26	30	16	1	30
Sebenico	44	3	0	16	34	30
Narenta	42	52	0	18	3	0
Cape Palli, N. Point	41	21	0	19	44	0
Capa Lenguetta	40	30	0	19	48	0
Butrinto	39	50	0	20	19	0
Cape St. Nicholas	39	34	0	20	30	0
Larta	39	8	0	21	22	0
Coron	36	47	26	21	58	37
Cape Matapan	36	23	20	22	29	15
Cape St. Angelo	36	26	30	23	13	0
Napoli	36	43	30	23	1	0
Corinth	37	53	22	23	2	0
Cape Doro Rock	38	9	59	24	37	4
Salonica	40	39	0	22	45	0
Lagos	40	58	0	25	3	0
Cape Macri	40	35	0	25	37	0
Dardanels	40	10	0	26	18	0
Galipoli	40	25	33	26	38	0
CONSTANTINOPLE	41	1	10	28	55	15

South Coast of the Mediterranean Sea.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Scutari	41	0	20N.	28	58	0E.
Cape Janisari	40	2	30	26	4	0
Cape Baba	39	45	0	25	56	0
Adramietta	39	34	0	26	58	0
Smyrna	38	28	7N	27	6	33E.
Cape Volpe	36	38	0	27	43	0
Macri	36	32	0	28	31	30
Seven Capes	36	18	0	28	37	0
Cape Chelidoni	36	20	0	30	21	0
Rosa Island	36	12	0	29	23	0
Satalia	37	2	30	30	31	0
Cape Draumonte	36	27	0	32	0	0
Cavelero Point	36	30	0	33	5	0
Cape Crio						
Yasso	36	44	0	36	4	0
Alexandretta or Scanderoon	36	35	0	36	15	0
Cape Porco	36	14	0	35	48	0
Aleppo	36	11	0	37	10	0
Tripoli	34	46	0	36	7	0
C. Vardo	34	30	30	35	48	0
Cape Serpente	33	36	0	35	37	30
Cape Blanco	33	17	0	35	32	0
St. John D'Acre	33	14	0	35	38	0
Jaffa	32	4	0	35	5	0
Cape Gallo	31	24	0	33	18	0
Damietta	31	31	0	32	0	0
Cape Bourlos	31	43	30	31	16	0
Rosetta	31	22	45	30	43	30
Aboukir	31	19	0	30	25	0
Nelson's Island	31	21	0	30	23	0
Cairo	30	2	21	31	18	30
Alexandria	31	11	20	30	11	15
Cape Rose	30	59	0	29	25	0
Cape Solomon	31	43	30	25	11	0
C. Razatin	32	28	0	23	15	0
Derne	32	51	0	21	52	0
Cape Rasat	33	1	0	20	27	0
Cape Mensurato	32	7	0	15	11	30
Tripoli	32	54	0	13	18	0
Cape Gergis	33	59	0	11	35	0
Cape Paul	35	11	0	11	9	0
Suza	35	39	0	10	45	0
Cape Bon	37	5	30	11	5	20
Tunis	36	46	0	10	16	0
Cape Blanco	37	27	0	10	7	0
Cape Roso	37	20	0	9	2	0
Cape Ferro	37	18	0	7	45	0
Cape Bugaroni	37	6	0	7	13	0
Cape Tedels	36	57	0	4	12	48
Cape Matifus	36	54	0	3	39	50
Algiers	36	48	36	3	0	5
Cape Tennis	36	32	15	1	18	3
Cape Ferrat	35	55	0	0	43	0W.
Cape Falcon	35	46	0	0	46	0
Cape Figalle	35	32	0	1	3	30
Cape Tres Forcas	35	27	55	2	57	25
Cape Negril	35	41	0	5	15	0
Tetuan	35	29	0	5	21	0
Ceuta Point	35	54	0	5	17	24
Tangier	35	48	0	5	49	0
Cape Spartel	35	48	40	5	54	25

Islands in the Mediterranean.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Alboran	35	57	0N.	3	1	55W.
Zaffarina	35	11	50	2	25	45
Formentera C. Mola	38	37	0	1	38	0
Ivica N. E. Point	39	3	0	1	37	0

Corsica.						
Cape Corse	43	1	30	9	22	0
Saint Fiorenzo	42	35	0	9	19	0
Calvi	42	34	0	8	43	0
Ajaccio	41	50	0	8	42	0
South Point	41	22	0	9	12	0
Tower Diana	42	8	0	9	34	0
Bastia	42	42	0	9	27	0
Sardinia.						
Cape Longo Sardo ..	41	14	30	9	8	0
Asinari, N. E. Point .	41	8	0	8	23	0
Cape Caccia	40	34	0	8	4	45
C. St. Marco	39	52	38	8	26	0
I. S. Pedro, W. Point	39	8	0	8	7	0
C. Teulada	38	51	0	8	36	0
Isle Toro (Rock)	38	50	0	8	17	0
Caglaria	39	14	0	9	7	0
C. Carbonera	39	7	0	9	28	0
C. Ferrato	39	23	30	9	42	0
C. Bellavista	40	2	30	9	52	0
C. Comino	40	34	0	9	53	30
I. Biche	41	5	30	9	35	0
Gorgona	43	25	0	9	54	0
Capraria	43	0	0	9	49	0
Elba, West End	42	44	0	10	3	0
Pianoza	42	34	0	10	4	0
Formigues	42	23	30	10	7	0
Monto Christo	42	20	30	10	18	0
Gilio	42	21	0	10	54	0
Ganulo	42	14	0	11	5	0
Palmaria	40	56	0	12	51	0
Ponza, South End ...	40	54	0	13	0	0
Ischia, South Point ..	40	40	30	13	55	0
Capri, S. W. Point ..	40	32	0	14	14	0
Sicily. Messina.						
Cape Orlando	38	8	0	14	53	0
Cape Cefula	38	1	30	14	7	0
Cape Cafrano	38	9	0	14	34	0
Palermo	38	6	45	13	21	45
Cape Gallo	38	12	30	13	24	20

Goza, ...
Malta, C. Com
La Valetta ....
P. Marza Siroc
Gulf of Ven
Fano ....
Pelegosa .....
Plana ....
Tremite ......
Lissa, South P
Pomo ....
Longa, S. E. P
Coronate, N. W
Sansego, S. Po
Brazza, N. W.
Palermo, Is. Lu
Curzula, W. P
Agusta, N. Poi
Melida, W. P
Cephalonia, S.
—Cape Viscar
Corfu, Point T
Paxu, N. W. I
Zante, S. Poi
Archipela
Cerigo, South
Cerigotto ....
Milo Town ..
Scio, Town ..
Mytelene Tow
Tenedos ....
Lemnos, N. I
Candi
Cape Crio ...
Cape Spada .
Suda ....
Cape Susa ..
Candia .....
Cape Sidera
Cape Salamo

TABLE XXVIII. Of Latitudes and Longitudes.

Coast of Africa, from Cape Spartel to the Cape of Good Hope.

Names of Places.	Latitude.			Longitude.		
	D.	M.	S.	D.	M.	S.
Cape Spartel	35	49	0N.	5	54	0W.
Larash	35	12	0	6	6	0
New Sale, or Rabat	34	3	0	6	47	0
Mazagan	33	18	30	8	25	0
Cape Blancho	33	10	0	8	38	0
Cape Cantin	32	34	0	9	5	0
Saffia, or Aziffin ..	32	20	0	9	2	0
Mogadore Island ..	31	27	0	9	36	0
Cape Geer	30	38	0	9	52	0
Santa Cruz	30	27	30	9	40	0
Cape Nun	28	40	0	11	15	0
Cape Blanca......	27	57	0	12	54	0
Cape Bajador	26	14	0	14	31	0
Horn Island, Entrance of Rio do Ouro	23	35	30	15	18	0
Cape das Barbas ..	22	15	30	16	39	45
Isle de Lobo......	21	7	10	17	15	0
Cape Blanco......	20	55	30	17	29	55
Cape St. Ann	20	42	30	16	35	0
Cape Myrick	19	12	30	16	21	0
Portendick	18	6	20	16	4	0
Barbary Point, Entrance of Senegal Bay......	51	53	0	16	31	15
Cape Verd	14	46	0	17	51	0
Breakers, off Ditto	14	50	30	17	58	0
Goree Island	14	40	50	17	40	0
Cape Naze	14	24	0	17	18	0
Cape St. Mary, Entrance to the River Gambia	3	17	0	16	56	0
Cape Roxo	12	23	0	17	10	0
Cape Vergu	9	52	0	14	56	0
Delos Isles	9	29	0	14	7	0
Cape Sierra Leon..	8	29	30	13	48	0
Cape Anne	7	7	0	13	27	0
Cape Mount......	6	46	0	11	42	0
Cape Monserrado ..	6	16	0	11	17	0
Cape Baxos	5	28	0	10	7	0
Sestos River......	5	27	0	9	47	0
Cape Formosa	5	8	0	9	39	0
Cape Palma	4	26	0	8	15	0
St. Andrew's River	4	58	0	6	30	0
Cape Maho	5	12	0	5	12	0
Cape Apollonia ..	4	59	0	3	11	0
Axim	4	52	0	2	36	0
Cape Three Points	4	40	0	2	38	0
Dix Cove	4	48	0	2	22	0
Sakondee	5	0	0	1	59	0
Elmina..........	5	10	0	1	40	0
Cape Corse Castle	5	12	0	1	48	0
Devil's Hill	5	24	0	0	50	0E.
Annamaboe Fort ..	5	10	0	1	7	0
Acra............	5	30	0	0	16	0
Barracoa	5	53	0	1	29	0
River Volta	5	53	0	1	25	0
Cape St. Paul	5	52	0	1	40	0
Whidah	6	25	0	3	13	0
Formosa River	5	53	0	6	10	0
Cape Formosa	4	30	0N.	6	40	0E.
New Callabar River	4	23	0	8	0	0
Cameron River....	3	20	0	10	0	0
Cape St. John	1	15	0	9	23	0
Gabon River	0	0	0	9	23	0
Cape de Lopez Gonsalvez....	0	47	0S.	9	12	0
Sesto River	2	16	0	9	35	0
Alvary Bay	3	27	0	10	40	0
Congo River......	4	35	0	11	5	0
Ambris River	6	45	0	12	0	0
Cape Ledo	9	50	0	12	3	0
S. Philip de Benguela	12	18	0	12	35	0
Cape Negro	16	0	0	11	44	0
Tigers Island	16	30	0	12	0	0
Cape Frio........	18	40	0	13	42	0
C. Rostro de Pedro	23	0	0	14	0	0
Angra Pequena....	26	35	0	15	40	0
Cape das Voltas ..	29	0	0	16	45	0
St. Helen's Bay ..						
Cape St. Martin's ..	32	45	0	17	45	0
Saldannah Bay....	33	8	0	18	0	0
Cape of Good Hope	34	29	0	18	23	0

Islands, Rocks, and Shoals, in the North Atlantic Ocean, and South Atlantic, or Southern Ocean.

Names of Places.	Latitude.			Longitude.		
	D.	M.	S.	D.	M.	S.
Rockal	57	13	0N.	14	18	0W.
Atkins Shoal	55	6	0	11	32	0
Chapel Rock, D. ..	47	34	0	7	12	0
—Rock, D.......	46	25	0	13	12	0
—Rock	36	30	0	23	10	0
Steen Ground	32	45	0	21	25	0
Josyna Rock......	30	46	0	24	41	0
Bermudas George Town	32	22	0	64	33	0
Breakers	32	35	0	57	45	0
Azores, or Western Islands.						
Corve, South Point	39	41	13	31	7	30
Flores, Pt. Delgada	39	33	29	31	7	0
Fayal, S. E. Point	38	30	12	28	41	36
Pico, Summit	38	27	0	28	28	0
—Point de Espertal	38	26	0	28	36	30
—East Point	38	22	0	28	6	0
St. George, S. E. Pt.	38	30	45	27	50	0
Graciosa						
—Villa da Praya ..	39	2	30	27	59	0
Terceira, Angra ..	38	38	10	27	13	34
St. Michael						
—Pta. Delgada ..	37	44	0	25	44	30
—Pta. Ferraria....	37	54	15	25	58	18
—North East Point	37	52	30	25	14	30
Formigas, or Ants	37	17	10	24	54	0
St. Mary, Town ..	36	57	40	25	12	0
—West Point	36	58	45	25	16	0
—Punta da Castello	36	57	0	25	6	0
Madeira Isles.						
Porto Santo, Town	32	58	15	16	25	0

—South Point	28	30	0	17	53	0
Ferro, Valverde ..	27	47	35	17	59	0
Gomero, Port	28	6	30	17	8	50
*Teneriffe						
—Hidalgo Point ..	28	36	10	16	21	0
—Oratava........	28	24	40	16	35	0
—Tena Point	28	20	0	16	57	0
—Peak..........	28	17	0	16	39	0
—Port Christianos	28	3	0	16	45	0
—Santa Cruz	28	28	0	16	16	0
Canary, N.E. Point	28	13	0	15	25	0
—Palmas	28	7	0	15	26	0
—South West Point	27	55	0	15	52	0
Fuerteventura						
—Point Gorda	28	46	0	13	52	0
—South West Point	28	4	0	14	32	0
Lanzarote, S. Point	28	51	0	13	47	0
—Puerto de Naos..	28	58	0	13	33	30
—Punta del Farion	29	15	0	13	29	0
Graciosa	29	17	0	13	31	0
St. Claire	29	18	30	13	32	0
Alegranxa........	29	25	0	13	30	30
Cape Verd Islands.						
St. Antonio						
—Santa Cruz	17	13	0	25	15	0
—South End	16	58	0	25	28	0
St. Vincent	17	1	0	25	6	0
St. Lucia, S. Point	16	46	0	24	55	0
St. Nicholas, N. Point	16	50	0	24	37	0
—East Point	16	30	0	24	12	0
Salt I. South Point	16	38	15	22	56	0
Bonavista, N. Point	16	3	40	22	45	0
Mayo, S. Point ..	15	6	0	23	10	0
St. Jago						
—Port Praya	14	53	40	23	31	0
Fogo, North Point	14	57	2	24	24	0
Brava, South Point	14	50	0	21	43	0
Porcas Bank, N. end	17	50	0	19	10	0

—Port Egmont....
—Cape Percival ..
Christmas Bay, I. Desolation ..
Aurora Island ..

South Georgia.

Cape Buller ......
Wallis Island ....
Cape Saunders....
Cape North ......
Cape George......
Sandwich Bay ....
Q. Charlotte's Cape
Cooper's Island....
Cape Disappointment........
Green Isles ......
Pickersgill Island ..
Clerk's Rocks ..

Sandwich Land.

Candlemas Islands
Saunders' Isle ...
Cape Montague ..
Cape Bristol......
Friesland Peak ....
Southern Thule ..

The Coast and a
Cape of G

Eastern Coast of Africa.

Cape of Good Hop
False Cape ......
Cape Agulhas ....
Cape St. Bras ....
Cape Talbado ....
Cape Delgado ....

TABLE XXVIII. Of Latitudes and Longitudes.

Names of Places.	Latitude.			Longitude.		
	D.	M.	S.	D.	M.	S.
Cape Delgado	10	6	0 S.	41	15	0 E.
Quiloa	8	41	0	39	40	0
Mombas	3	34	0	41	30	0
Melinda	2	45	0	41	47	0
Magadosha	2	20	0 N.	46	25	0
Cape Bassas	4	50	0	49	2	0
Cape Orfui	10	29	0	51	38	0
Cape Guardafui	11	47	0	51	35	0
The Red Sea.						
Cape Babelmandel	12	35	0	43	28	0
Socotoro I. E. Point	12	15	0	54	55	0
Cape Fartash	15	29	0	52	5	0
Suez	30	2	0	32	28	30
Judda	21	29	0	39	22	0
Mecca	21	40	0	41	0	0
Moka	13	16	0	44	0	0
Coast of Arabia.						
Cape Aden	12	45	0	45	17	0
Cape Morebat	17	16	0	54	19	0
Cape Pedro	17	54	0	55	27	0
Cape Isolette	19	4	0	57	18	0
Great Mazeira I.	20	15	0	58	31	0
Cape Rosalgate	22	36	0	59	54	0
Muscat	23	30	0	58	16	0
Gulf of Persia.						
Cape Musseldom	26	17	0	56	17	0
Cape Jask	25	57	0	57	15	0
Gambaroon	27	18	0	56	6	0
Bassora	30	31	0	47	32	0
Malabar Coast.						
Cape Monze	25	0	0	66	18	0
Point Gigat	23	30	0	68	35	0
Diu Point	20	44	2	69	50	0
Cambay	23	36	0	72	17	0
Surat	21	10	0	72	26	0
Damaun	20	22	0	73	2	45
Omergon	20	10	30	72	56	30
St. John's Cape	20	6	0	72	34	0
Basseen Fort	19	19	0	72	55	24
Bombay	18	55	42	72	54	24
— Lighthouse	18	53	0	72	52	54
Coullaba Island	18	37	20	72	56	30
Bancoot	17	56	40	73	7	54
Severndroog	17	47	30	73	9	0
Dabul	18	0	0	74	29	0
Gheriah	16	37	0	73	22	24
Vingorla Rocks	15	55	30	73	30	0
Goa	15	31	0	73	55	0
Aguado Point	15	28	55	73	48	0
Carwar Head	14	47	0	74	12	30
Barcelore	13	53	0	75	2	0
Permira Rocks	13	13	0	74	4	0
Mangalore	13	0	0	75	35	0
Mount Dilly	12	5	0	75	35	0
Cananore	11	51	0	75	25	0
Sacrifice Rock	11	28	0	75	31	5
Calicut	11	20	0	75	50	0
Cranganore	10	17	0	76	6	0
Cochin	9	58	0	76	15	34
Quilon	8	52	30	76	37	0
Anjango Roads	8	39	25	76	50	0

Names of Places.	Latitude.			Longitude.		
	D.	M.	S.	D.	M.	S.
Coromandel Coast.						
*Cape Comorin	8	4	0 N.	77	33	50 E.
Manapar Point	8	29	0	78	15	0
Trinchindore Pagoda	8	37	0	78	24	0
Point Calymere	10	18	0	79	54	0
Negapatam	10	42	0	79	54	0
Tranquebar	10	56	0	79	40	30
Devicotta	11	21	0	79	47	0
Porto Nova	11	30	0	79	45	30
Cuddalore	11	41	0	79	37	45
Poudicherry	11	42	0	79	59	0
Madras	13	5	0	80	35	0
Point Divy	16	2	0	81	29	0
Masulipatam	16	16	0	81	24	0
Point Gordewar	16	45	0	82	37	0
Coringa Bay	16	58	0	82	30	0
Visigapatam	17	46	0	83	15	0
Ganjam	19	25	0	85	7	0
Jagernaut Pagoda	19	48	0	85	57	0
Black Pagoda	19	51	0	86	10	0
False Point	20	17	0	86	51	0
Point Palmiras	20	44	0	87	10	0
Balasore	21	21	0	87	21	0
Ingerlee Pagoda	21	50	0	88	11	0
Kedgeree	21	48	0	88	50	0
*Calcutta						
— Fort William	22	34	45	88	27	56
Chandernagor	22	51	0	88	30	0
Pegu.						
Islamabad, or Chittagong	22	20	0	91	52	0
Aracan River	20	17	0	93	0	0
Cheduba Island	18	45	0	93	37	0
Cape Negrais	16	8	0	94	9	0
Diamond Isle	15	50	0	94	17	54
Malay.						
Tavay Point	13	37	0	97	44	0
Mergui	12	10	30	98	19	15
Junk Seylon	8	15	0	98	2	0
Pulo Penang, or P. of Wales's Island						
— Fort Cornwallis	5	27	0	100	25	0
Malacca	2	12	0	102	11	0
Cape Romania	1	15	0	101	5	0
Siam	14	18	0	100	55	0
China.						
Camboja Point	8	45	0	103	45	0
Cape Avarello	12	54	0	107	50	0
Pulo Canton	15	15	0	107	15	0
Turon Bay	16	4	0	106	30	0
Macao	22	13	0	113	52	0
Grand Ladrone	22	2	0	113	56	0
Canton	23	6	57	113	16	7

Islands, Rocks, and Shoals, in the Indian Ocean.

Marseveen	41	30	0 S.	20	46	0 E.
Denia	40	48	0	20	25	
Fortune Shoal	33	8	0	43	5	

St. Paul	38	44	0	77	18	0	South Roquepiz ..
Cloate's Island	21	45	0	93	27	0	Speaker's Bank....
Trial Rocks	20	40	0	104	30	0	Peros Banhos ....
Christmas Island	10	35	0	104	49	0	Boddam's Island ..
Keeling's Islands	12	3	15	97	38	30	Diego Garcia ....
Madagascar Island.							Candu Islands ....
Cape St. Mary	25	30	0	44	55	0	Adu Islands ......
St. Augustin's Bay ..	23	35	0	43	30	0	Maldive I. S. E. Pa
Cape St. Vincent	21	46	0	43	37	0	—N. W. Part ....
Cape St. Andrew's ..	16	6	0	45	32	0	Maldive Islands ...
Cape St. Sebastian ..	12	30	0	49	44	0	Laccadive Isles,
Cape Ambro, or Natal	12	2	0	50	19	0	—N. W. Part ....
Antongil Bay, Entr.	15	27	23	50	23	30	—S. E. Part .....
St. Mary's Island ...	16	54	0	50	36	0	*Ceylon Island.*
Juan de Nova	17	15	0	43	7	0	—North Point ...
Foul Point	17	41	0	49	59	0	Point de Galle ...
Port Dauphin	25	0	0	47	5	0	—South Point ....
Mozambique Passage.							Grand Bassas .....
Bassas de India	22	20	0	41	30	0	Elephant Point ...
Europa Rocks	21	30	0	40	17	0	Trincomaley .....
Sussex Rocks	21	29	0	42	26	0	Bale of Cotton Ro
Bazaruto Rocks	21	16	0	36	30	0	——
English Bank	17	30	0	39	27	0	Preparis Island ...
St. Christopher's Isl.	17	10	0	43	50	0	Cocos Island,
Coffin Island	17	28	0	44	7	0	—Great Cocos ...
Chesterfield Shoal ...	16	17	0	44	0	0	—Little Cocos ....
Comoro Isles.							*Andaman Island.*
Mayotta	12	47	0	45	30	0	Great Andaman,
Johanna Island	12	15	0	44	35	0	—North Point ...
Mohilla	12	30	0	43	55	0	—South Point ...
Comoro	11	32	0	43	30	0	—Port Cornwallis .
——							Little Andaman,
John Martin's Island	10	9	0	43	15	0	—South Point ...
Portuguese Shoals ...	12	33	0	46	55	0	——
Aldabra Islands	9	40	0	46	45	0	Barren Island .....
Assumption	9	46	0	47	37	0	Narcondam Island
Cosmoledo Islands ...	9	46	0	48	38	0	*Nicobar Isles.*
Sandy Islands	9	16	0	48	12	0	—North Point ..
Natal Island	8	30	0	47	15	0	—South Point ..

Islands, Rocks, and Shoals, between the Indian and Pacific Oceans, from Sumatra to New Guinea.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Sumatra.						
Lucepara Point ...	3	11	20S.	106	18	40E.
Bencoolen	3	49	9	102	10	30
Achen Head	5	30	0	95	30	0
Straits of Malacca and Sincapore.						
Pulo Way, E. P. ..	5	42	0	95	33	0
Pulo Rondo, Ronde	0	5	59N.	95	13	0
Pulo Brasse, E. Pt.	5	32	0	95	11	0
Cocos Isles.......	3	15	0	95	52	0
Hog Island, S. Pt. .	2	30	0	95	45	0
Pulo Nias	0	57	0	97	2	0
Pulo Minton, S. Pt.	0	25	0S.	97	45	0
Good Fortune Isles, —South Point	1	57	0	99	49	0
Nassau Id. S. Point	3	15	0	100	25	0
Enganno Island ...	5	20	0	101	54	0
Pulo Pera........	5	46	0N.	99	8	30
Pulo Penang, or Pr. of Wales's Island.......	5	27	0	100	25	0
Pulo Jarra	3	57	0	100	17	0
Ent. of China Sea.						
Bintang, E. Entrance to the Straits of Sincapore.......	0	18	0S.	105	15	0
Pedra Branca	1	18	0N.	104	31	49
Pulo Aroe	2	28	0	103	30	0
Pulo Tinoy I......	2	30	0	105	52	0
Pulo Aor	2	40	0	104	43	0
Pulo Timon, S. Pt.	2	49	0	104	24	0
Anambas Isles.						
Pulo Domar......	2	47	0	105	21	0
South Anambas ...	2	47	0	106	15	0
Saddle Island	2	17	0	105	44	0
Victory's, or Wood I.	1	34	0	105	47	0
Condor..........	8	40	0	105	45	0
Ent. of China Sea.						
Natuna Island	4	5	0	108	10	0
St. Julian's Island .	0	45	0	106	38	0
Timbelan's Island..	1	0	0	107	15	0
Sprit Island	0	7	0	106	30	0
Billiton, S. E. Point	3	6	0S.	108	15	0
Gaspar Island.....	2	25	0	107	7	45
Banca Island.						
Point Pleasant, N. P.	1	33	0	106	0	0
Monopin Hill	2	1	20	105	21	7
East Point	3	4	0	106	17	0
Lucepara Island...	3	10	45	106	17	30
The Seven Islands .	1	5	16	105	24	4
Princes' Island....	6	36	25	105	15	15
Oracaloe Island ...	6	6	0	105	31	40
Straits of Sunda.						
Caracatoa	6	6	0	105	36	0
Peck-on, Tamarind Island ...	6	54	0	105	18	0
North Island	5	37	5	105	55	0
Pulo Babee, E. Ent.	5	45	0	106	20	30

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Java Sea.						
The Brothers	5	1	20S.	106	14	0E.
Jason's Rock	5	30	0	107	21	0
Pulo Rachel......	5	53	0	108	3	0
Carimon Java, E. most.........	5	48	0	109	25	0
Luber Island	5	43	0	111	41	0
Great Salombo....	5	28	0	113	18	0
I. Salombo, S. most	5	33	0	113	13	0
Bratthron Shoals ..	5	30	0	113	41	0
Java Island.						
Java Head, W. Pt.	6	48	0	105	5	0
Anjer Point	6	3	17	106	1	57
Bantam Point	5	50	20	106	9	3
Batavia..........	6	11	0	106	50	0
Indermay Point ...	6	13	0	109	4	0
Cape Sandana	7	39	0	114	36	0
East Point	8	39	0	114	40	0
Wessels Bay......	8	28	0	112	38	0
Turtle Bay	8	0	0	109	37	0
Winerow Point....	7	25	0	106	5	0
Eastern Straits to China.						
Bally Island, S. Point	8	56	0	115	23	0
Bally Str. S. Ent...	8	45	0	114	47	0
Lombock Straits...	9	10	0	115	57	0
Straits of Mass....	9	0	0	116	50	0
Little Paternosters,						
—Southernmost...	2	13	0	117	12	0
—Northernmost...	2	15	0	117	12	0
Tonekaky	5	31	0	117	17	0
Straits of Sapy....	8	30	0	119	32	0
Sandelwood Island .	9	45	0	120	0	0
Rotto Island, S. End	11	15	0	123	7	0
Banda Sea.						
Timor I. W. Point.	10	15	0	123	43	0
—South Point	10	23	0	123	58	0
Timor Laoot, S. Pt.	8	15	0	131	50	0
Timorland, S. Point	8	3	0	132	17	0
Amboyna	4	25	0	127	25	0
Gillolo, North End	2	17	0N.	127	20	0
—West End	1	8	0	127	1	0
Heri Island	0	59	0	126	54	0
Ternate Island	0	57	0	126	53	0
Celebes, N. Point .	2	0	0	124	0	0
—South Point	5	42	0S.	120	6	0
Mariane Island....	0	21	0	126	40	0
Sutta Mangle Island	1	48	0	126	17	0
Sutta Bassia	2	36	0	125	41	0
Burro Island, W. Pt.	3	3	0	125	43	0
Cambona Island ...	5	29	0	121	26	0
Donthin Hill	5	30	0	117	53	0
Macassar Town ...	5	11	0	117	28	0
Tonyn Island	5	27	0	118	2	0
Straits of Macassar.						
Bouton Island, S. P.	5	42	0	121	11	0
N. E. End of a Shoal off Bouton Island....	5	25	0	122	8	0
Tocca Bassia Island	5	35	0	123	15	0
Saleyer Straits	5	44	0	120	6	0
Borneo Island.						
North Point	7	0	0N.	116	45	0
Unasang Point, E.P.	5	15	0	118	50	0
Point Salatan, S.E.P.	4	15	0S.	114	25	0

TABLE XXVIII. Of Latitudes and Longitudes.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Point Sambar, S. W. Point	2	45	0S.	109	28	0E.
Bangney	7	17	0	117	30	0
Balambangan Island	7	30	0N.	117	2	0
Palawan, S. Point..	8	28	0	117	30	0
—North Point	11	20	0	119	46	0
Sooloo, East Point	5	57	0	121	21	0
Sooloo Island, S. Pt.	5	57	0	121	15	30
—Temoutanges ...	5	57	0	120	53	30
Philippine Islands.						
Mindanao........						
—Pt. St. Augustine	6	15	0	127	20	0
—Mindanao, S. Pt.	5	34	0	126	5	0
Goat Island	13	55	0	120	2	0
Luconia, N. Point .	18	45	0	120	45	0
—Manilla	14	36	8	120	51	15
Bastrees Islands.						
Grafton	21	4	0	121	0	15
—Kumi	24	33	13	122	46	43
Hoapainsu	25	49	39	122	40	0

Islands, Rocks, and Shoals, in the China Sea.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Pulo Brata	4	45	0N.	103	30	0E.
Ridang Island.....	6	20	0	102	37	0
Pulo Coron.......	7	17	0	102	30	0
Pulo Way	10	0	0	102	34	0
Pulo Uby	8	30	0	103	45	0
Two Brothers	8	32	0	105	37	0
Pulo Condor.......	8	40	0	106	31	37
Pulo Sapata	10	4	30	109	13	0
Shark's Bay	25	29	45	113	27	50
I. Rottenest, W. P.	31	58	0	115	24	45
Geography Bay ...	33	29	50	115	23	15
Cape Lewin	34	25	41	114	58	47
I. St. Alourn	34	27	10	115	2	50
Cape Chatham	35	3	0	116	35	0
King George's Port	35	3	30	118	1	45
Point Hood	34	23	0	119	49	0
Bay of Saints	32	10	50	133	54	13
Kangaroo Bay	35	43	30	138	7	15
King's Island						
Bay of Elephants ..	39	53	1	144	32	55
Elephant Island ...	10	4	0	108	42	0
Pitt's Island	10	55	0	114	35	0
Sandy Island......	10	40	0	112	48	0
Smallkey	10	37	0	112	44	0
Long Island	10	20	0	112	36	0
New Island	10	10	0	112	20	0
First Shoal.......	10	14	0	112	24	0
Second Shoal.....	10	4	0	112	15	0
Third Shoal	10	5	0	112	10	0
Reef	10	15	0	112	0	0
Scarborough Rocks	15	0	0	117	12	0
Macclesfield Shoal,						
—North Point	16	6	0	114	10	0
—South Point	15	15	0	114	20	0
Triangles, N. Point	17	0	0	111	0	0
—*South Point*	16	0	0	111	32	0
Pratas Rock, N. Side	20	57	30	116	57	30
—*S. W. Side*.....	20	42	0	116	40	0

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Paracel's, North Part	16	30	0N.	110	0	0E.
—South Part.....	11	37	0	109	30	0
Hainan, North Point	20	2	0	110	15	0
—South Point	18	12	0	109	20	0

The Coast and adjacent Islands from Canton to Cape North.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Canton	23	6	57N.	113	16	7E.
Macao	22	13	0	113	52	0
Grand Ladrone....	22	2	0	113	56	0
Southernmost.....	8	0	0	114	6	0
Ningpo..........	29	57	45	120	18	0
Pekin	39	54	47	116	24	51
Cape Lopatka.....	51	0	15	156	42	30
Cape Gavareea	51	20	0	158	36	0
St. Peter and St. Paul	52	51	45	158	46	30
Kronotskos Noss ..	54	43	0	162	13	30
Kamschatka Noss..	56	1	3	163	18	30
Thadeus Noss	62	50	0	179	5	0
Cape Ischukotskoi .	64	14	30	173	31	0
East Cape	66	5	30	169	9	30
Sardz Kamen	67	3	0	171	54	30W.
Cape North	68	56	0	179	11	30
Grafton Island	20	4	0	120	0	0E.
Formosa Isl. S. End	22	5	0	120	50	0
—Tayoan	22	40	0	120	20	0
—North End	25	15	0	122	13	0
Great Lequeo, S. P.	25	15	0	128	30	0
—North Point	28	0	0	128	30	0
Xuno Island S. Point	31	30	0	131	50	0
—North Point	34	45	0	131	30	0
Japan...........						
Nangasaki	32	44	0	129	52	0
Niphon Isl. S. End	33	30	0	135	0	0
—North End.....	41	0	0	142	0	0
Matoosmaee......	42	30	0	140	30	0
Mednoi Island	54	27	0	167	55	45
Beerings Island ...	55	36	0	167	46	0
St. Lawrence Island	63	47	0	171	45	0

The Coast of New Holland, and adjacent Islands.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Switley Island	43	55	0S.	147	7	30E.
South Cape	43	42	0	146	58	0
South West Cape..	43	37	30	146	5	30
Mew Stone.......	43	47	15	146	26	30
Tasman's Head....	43	33	30	147	33	30
Point Recherche...	43	32	23	147	6	15
Adventure Bay	43	21	20	147	31	40
Cape Howe.......	37	31	15	145	31	0
Point Dromedary ..	36	18	0	150	5	0
Cape St. George...	35	19	0	150	18	0
Red Point	34	29	0	151	15	0
Botany Bay	34	6	0	151	23	0
Port Jackson	33	50	0	151	25	0
Port Stephens	32	40	0	152	9	0
Cape Hawke......	32	14	0	152	30	0
Smoaky Cape (near)	30	31	0	153	6	0
Cape Byron	27	27	30	153	30	0
Point Danger	28	8	22	153	33	10
Indian Head......	25	3	0			
Cape Moreton	26	56	0	153	32	0
Bustard Bay	24	4	0	151	44	0

Names of Places.	Latitude.			Longitude.		
	D.	M.	S.	D.	M.	S.
Sandy Point	24	45	0S.	153	9	0E.
Cape Capricorn ..	23	29	0	151	2	0
Cape Townshend ..	22	15	0	150	17	0
Trinity Sound	22	10	0	149	42	0
Cape Palmerston ..	21	30	0	149	6	0
Cape Conway	20	36	0	148	32	0
Cape Gloucester ..	19	59	0	148	11	0
Cape Upstart	19	36	0	147	28	0
Cape Sandwich....	18	17	11	146	1	13
Cape Grafton	16	57	0	145	54	0
Cape Tribulation ..	16	6	0	145	21	0
Endeavour River ..	15	26	0	145	14	41
Cape Bedford	15	16	0	145	15	0
Cape Flattery	14	56	0	145	17	0
Cape Weymouth ..	12	42	0	142	45	0
Cape Granville	11	58	0	142	22	0
York Cape	10	37	0	141	36	0
Cape Cornwall	10	43	0	141	0	0
I. Possession......	10	42	0	141	24	15
Endeavour Straits..	10	39	0	141	24	0
Islands and Rocks, &c. in the Pacific Ocean.						
Sledge Island	64	30	0N.	166	8	0E.
Clerk's Island	61	15	0	169	40	0W.
Anderson's Island..	60	17	0	162	31	0
Gore's I. C. Upright	60	22	0	172	26	0
Key's I. S. W. End	59	48	0	143	8	30
Round Island	58	56	30	153	30	0
S. Hermogenes Isl.	58	15	0	152	13	0
Trinity Island	56	35	0	154	58	0
Foggy Island	56	12	0	157	19	30
Oonemak Island ..	54	30	30	167	31	0
Cooper's Isl. S. Pt.	54	24	0	169	0	0
Oonalaska.........	53	54	45	166	26	0
Sulphur Island	24	48	0	141	20	0
North Island	25	14	0	141	14	0
South Island	24	22	30	141	24	0
Tinian	14	58	0	145	5	0
St. Andrew's Island	5	18	0	133	40	0
Dangerous Shoal ..	2	53	0	136	10	0
Free-will, or St. David's Islands	0	50	0	137	51	0
Pelew Islands	7	19	0	134	40	0
Piscadores, N. End	11	20	0	165	44	0
.. South End	11	0	0	166	45	0
Ocyhee, N. Point..	20	17	0	155	59	0
—South Point....	18	54	30	155	48	0
—East Point	19	33	0	154	52	0
Mowee, East Point	20	50	30	155	55	0
—South Point....	20	34	30	156	12	30
—West Point	20	53	30	156	38	30
Kerajegoa.........	19	28	0	156	2	15
Tahowrooa	20	38	0	156	36	0
Moozokinnee	20	39	0	156	29	30
Rannai, South Point	20	46	30	156	55	30
Morotai, W. Point	21	10	0	157	17	0
Woodhoo.........	21	42	30	158	1	30
Tahoora	21	42	30	160	24	30
Oreehowa.........	22	3	0	160	6	30
I. Nekar	23	34	0	164	31	45
Oimea Road.......	21	57	0	159	39	30
Oneeheow	21	49	30	160	13	30

Names of Places.	Latitude.			Longitude.		
	D.	M.	S.	D.	M.	S.
Whyteeie Bay	17	30	20N.	157	50	23 W.
Owhyee, Whymea Road	21	57	30	159	41	45
Christmas, or Noel I.	1	57	45	157	35	0
Socona I. Middle..	18	48	0	110	10	0
Cape False	8	40	0S.	136	30	0E.
East Point	6	20	0	148	0	0
Louisiade Isles, E. P.	10	35	0	154	0	0
—West Point	1	30	0	148	30	0
Stephen's Island ..	0	22	0	139	39	0
Durour's Island ..	1	15	0	143	21	0
Matty's Island	1	45	0	143	2	0
Admiralty Islands.						
Mid. of the largest	2	18	0	146	44	0
Portland Isles, Mid.	2	27	0	148	3	0
Cape Byron	2	30	0	149	2	0
Duke of York Island	4	9	0	151	20	0
New Ireland, E. Pt.	5	0	0	152	30	0
—West Point	2	20	0	148	20	0
Cape St. George ..	4	53	30	152	19	0
Queen Charlotte's Foreland	2	29	0	148	27	0
Sandwich Isl. Peak	2	53	0	149	17	0
N. Britain, East Pt.	4	53	0	153	9	0
—West Point	6	0	0	149	20	0
Port Praslin	4	49	27	153	6	30
Nine Islands......	4	36	0	154	17	0
Bouganville Straits	7	5	0	158	56	0
Solomon Islands.						
Boca, North Point	5	0	0	154	27	17
Eddystone	8	18	20	156	22	0
Cape Deception ..	8	26	0	159	14	0
Kepple's Island ..	10	15	0	165	4	0
Cape Surville	10	50	30	162	21	58
I. Volcan	10	25	12	165	48	21
Edgecomb's Island	11	10	0	165	14	0
Ourry's Island	11	10	0	165	19	0
Egmont Isle						
Cape Byron, N. E.	10	40	0	166	49	0
Lord Howe's Island	11	10	0	164	43	0
New Hebrides.						
I. or Pic de l'Etoile	14	29	0	168	9	15
Cape Cumberland..	14	39	30	166	47	0
Cape Queros	14	56	0	167	20	0
Leper's Island, N.E.	15	16	45	168	10	45
—South West	15	30	0	167	45	30
Maskelyne's Islands	16	30	0	167	58	30
	16	33	45	168	1	30
	16	32	30	167	59	30
	16	33	0	167	59	15
Mallicolo, S. Cape	16	38	0	167	42	30
—S. W. Cape	16	31	0	167	36	30
Cape Sandwich....	16	28	0	167	59	0
Sandwich Harbour	16	25	20	167	53	0
I. of Ambrim	16	9	30	168	12	45
Cape Lisburne	15	40	45	166	57	0
St. Bartholomew I.	15	42	0	167	17	30
Aurora, North End	14	52	0	168	13	0
—South End	15	24	0	168	20	45
Table Island	15	38	0	167	7	0
Whitsuntide I. N. e.	15	28	30	168	21	30
—South End	16	0	25	168	19	0
Ambrym Island, N. E. End ..	16	4	0	168	21	25
—West End	16	15	0	168	3	30

Sandwich Island, From	17	29	0	168	20	30
to	17	53	0	168	45	25
Traitor's Head	18	43	30	169	20	30
Small Island off	18	41	0	169	26	0
I. Erromanga	18	46	30	169	18	45
Inmer	19	16	0	169	46	0
Tanno I.l. From	19	16	30	169	21	0
to	19	38	30	169	43	0
Port Resolution	19	32	24	169	41	20
Inanama	19	31	0	170	21	0
Enatum	20	10	0	170	4	0
New Caledonia.						
Belleabea Island	20	7	0	164	22	0
Pudyona Obs.	20	18	10	164	41	12
Cape Colnet	20	30	0	164	56	0
Cape Coronation	22	5	0	167	8	0
Queen Charlotte's Foreland	22	15	0	167	12	4
Isle of Pines	22	38	0	167	38	0
Botany Isl. anch. off	22	26	40	167	16	45
Norfolk Island	29	1	45	168	10	0
New Zealand.						
Three Kings	34	12	0	172	12	0
Cape Maria	34	30	0	172	42	0
North Cape	34	22	0	173	5	0
Mount Camel	34	51	0	173	10	0
Cape Brent	35	10	30	174	40	0
Cape Colville	36	26	0	175	33	0
Mercury Bay	36	47	0	175	56	0
Cape Runaway	37	32	0	178	12	0
East Cape	37	42	30	179	0	0
Mount Edgecumbe	37	59	0	166	53	0
Tolaga Bay	38	22	24	179	13	0
Poverty Bay	38	42	0	178	24	0
Albatross Point	38	4	0	175	18	0
Cape Table	39	7	0	178	24	0
Mount Edgecumb	39	16	0	174	45	0
Table Head	39	17	0	177	59	37
Shambles	39	20	0	178	20	45

Duke of York's Isl.
Wallis's Island
Keppel's Island
Boscawen's Island
Navigation Isles.
I. Opoun
—Leone
—Mahouna
—Pola
Port Refuge
Savage Island
Agyoau
Hapae, North Poin
Mattafoa
Turtle Island
Annamooka
Tongotaboo, Randermain Road
Annamoke Ette
Commango Ette
Commango
Tonamai
Tellefageo
Morotoi
Eaoowe
Pylstaart's Island
Oheteroa
Toobovai
Palmerston Island
Whylotack
Harvey's Island
Owhyhee
Wateoo Island
Mangea Island
Society Islands
Scilly Island
Ohamaneno
Howe's Island
Marua Island

[redacted]

TABLE XXVIII. Of Latitudes and Longitudes.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Oheteroe	22	36	30S.	150	48	45W.
Toobouai	23	25	0	149	20	30
Taookaa Island	14	30	30	145	9	30
Adventure Island	17	6	20	144	17	45
Furneaux Island	17	11	0	143	6	40
Resolution Island	17	23	15	141	45	0
Bird Island	17	48	0	143	35	0
Groups, S. Eastmost	18	12	0	142	42	0
Bow Island, E. end	18	23	0	141	12	0
Prince Henry's I.	19	0	0	141	6	0
Cumberland Island	19	18	0	148	36	0
Gloucester Island	19	11	0	140	4	0
Q. Charlotte's Island	19	18	0	138	4	0
Egmont Island	19	20	0	138	30	0
Whitsunday Island	19	26	0	137	56	0
Lagoon Island	18	47	0	139	28	0
Thrumb Cap	18	35	0	139	48	0
Osnaburg Island	17	51	0	147	30	0
Blight Lagoon Island	21	38	0	140	37	0
Pitcairn's Island	25	2	0	133	30	0
Oparo	27	36	0	144	1	32
—						
Hood's Island	9	26	0	138	52	0
Ohevahoa	9	40	36	139	1	22
Ohjtahoo Harbour	9	55	30	139	8	40
Onateaya	9	58	0	138	51	0
Magdalena	10	25	30	138	49	0
Easter Island	27	8	30	109	51	45
Felix and Amb	27	38	0	79	45	0
Massafuero	33	45	30	80	36	0
Juan Fernandez	34	20	0	78	55	45
Galepagos Isle } I. Albemarle }	0	2	0N.	91	30	0

West Coast of America, from Icy Cape to Cape Horn.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Icy Cape	70	29	0N.	161	42	30W.
Cape Lisburn	69	5	0	165	22	30
Cape Mulgrave	67	45	30	165	12	30
Cape P. of Wales	65	45	30	168	17	0
Norton Sound	64	30	0	162	47	30
Cape Darby	64	21	0	163	0	0
Cape Stephens	63	33	30	162	16	30
Shoalness	57	37	15	162	18	15
Cape Newnham	58	41	30	162	19	30
Bristol River	58	27	0	158	7	30
Cape Barnabas	57	10	0	152	15	0
Cape Grenville	57	31	0	152	37	30
Cape Elizabeth	59	11	0	152	12	0
Port Chatham	59	14	0	150	56	0
Chiswell's Isles	59	31	0	148	50	0
Mount St. Elias	60	24	30	141	0	0
Cook's Inlet, N. end	61	29	0	148	43	0
Point Pigotess	60	47	30	147	43	30
Point Pakenham	60	59	30	147	31	0
Point Countess	60	13	0	147	29	30
Point Culroso	60	45	0	147	28	0
Point Nowell	60	27	0	147	17	30
Point Pelew	60	51	0	147	3	0
Point Freemantle	60	57	0	146	26	0
Cape Hinchinbrook	60	16	30	146	4	0
Port Chalmers	60	16	0	146	37	45
Cape Hammond	59	48	30	144	9	15

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Point Riou	59	47	0N.	140	43	0W
Knight's Island	59	44	0	139	9	0
Point Latouch	59	51	0	139	15	30
Cape Fairweather	58	50	30	137	40	0
Port François	58	37	0	137	8	0
Cape Edgecombe	57	2	0	136	26	5
Cape Cross	57	58	30	136	4	30
Point Dundas	58	21	0	135	59	0
Point Adolphus	58	16	0			
Point St. Mary's	58	43	30	134	58	0
Point Converden	58	12	0	134	53	0
Point Retreat	58	24	0	134	48	0
Point Parker	57	37	0	134	31	0
Port delos Remedios	57	21	0	135	30	0
Point Sullivan	56	38	0	134	8	30
Point Ellis	56	31	0	134	4	0
Point Malmesbury	56	17	30	134	2	0
Port Conclusion	56	15	0	134	23	40
Cape Ommaney	56	9	40	134	22	30
Point Salisbury	58	0	0	133	57	0
Point Macartney	57	1	30	133	48	0
Point Styleman	57	53	0	133	38	0
Port Protection	56	20	30	135	25	0
C. St. Bartholomew	55	12	15	133	25	20
Point Windham	57	31	0	133	24	0
Cape Fanshaw	57	11	0	133	15	30
Point Hood	56	44	0	132	49	0
Point St. Alban's	56	7	0	132	42	0
Point Macnamara	56	21	30	132	46	30
Point Blaquire	56	39	0	132	20	0
Point Stanhope	56	2	0	132	22	0
Point Highfield	56	34	0	132	12	0
Point Le Mesurier	55	46	0	132	2	0
Point Warde	56	9	0	131	49	43
Cape Camano	55	29	0	131	43	0
Point Stewart	55	38	15	131	36	0
Point Higgins	55	27	30	131	35	0
Escape Point	55	37	0	131	30	0
Point Lees	55	54	0	131	14	0
C. Northumberland	54	51	30	131	4	30
Fog Point	54	54	30	130	49	0
Point Nelson	55	15	0	130	42	30
Cape Fox	54	45	30	130	38	0
Cape Muzon	54	42	30	132	31	0
Cape Ibbetson	54	4	0	130	30	0
Point Hunt	54	10	30	130	12	0
Point Maskelyne	54	42	30	130	15	0
Point Ramsden	54	59	0	129	57	0
Point Lambert	54	10	30	129	53	30
Banks's Island	53	26	30	129	41	0
—North Point	53	39	30	130	13	0
Salmon Cove, Obs. Ia.	55	15	34	129	43	30
Fisherman's Cove	53	18	30	129	7	0
Point Cumming	53	18	30	129	2	0
Point Ashton	53	50	0	128	51	30
Point Staniforth	53	34	0	128	43	0
Cape Swain	52	13	0	128	20	0
Carter's Bay	52	48	0	128	18	0
Point Raphoe	52	43	30	127	5	0
Point Edward	52	25	30	127	22	30
Point Menzies	52	18	30	127	5	0
Cape St. James	51	58	0	130	53	30
Point Walker	51	56	30	127	51	0
Calvert's Island	51	27	0	127	55	[illegible]
Smith's Inlet (Ent.)	51	18	0	127	48	[illegible]

Point of Breakers ...	49	25	0	126	28	0
Point Chatham	50	19	30	125	15	0
Point Mudge	50	0	0	124	51	0
Point Sarah	50	4	30	124	34	30
Point Marshal	49	48	0	122	12	30
Savery's Island	49	57	30	124	5	30
Destruction Island ..	47	37	0	124	11	0
Scotch Fir Point....	49	42	0	123	43	0
Point Upwood	49	28	30	123	36	0
Point Gower	49	23	0	123	9	0
Point Grey	49	19	0	122	54	0
Anvil Island	49	30	0	122	57	0
Point Roberts	48	57	0	122	40	0
Cape Flattery	48	24	0	124	22	0
Point Partridge	48	16	0	122	29	0
Point Wilson	48	10	0	122	29	0
Birch Bay	48	53	30	122	27	0
Strawberry Bay	48	36	30	122	26	0
Port Discovery	48	7	80	122	89	30
Penn's Cove	48	17	0	122	22	0
Oak Cove	47	53	0	122	24	0
Possession Sound ..	47	53	0	122	13	0
Point Grenville	47	22	0	124	1	30
Admiralty Inlet	47	3	0	122	42	0
Cape Disappointment	46	19	0	123	51	0
Point Brown	47	0	0	123	53	0
Colombia River	46	19	0	123	53	0
Mount St. Helens ..	46	9	0	121	6	0
Mount Olympus....	47	50	0	123	26	0
Restoration Point ..	47	30	0	122	14	0
Cape Lookout	45	32	0	123	49	0
Cape Foulweather ..	44	49	0	123	56	0
Cape Perpetua	44	12	0	123	55	0
Cape Gregory	43	23	0	124	10	0
Cape Blanco	43	6	0	124	18	0
Cape Orford	42	52	0	124	25	0
Trinity Bay	41	3	0	123	54	0
Cape Mendecino ..	40	10	0	124	27	0
Point d'Arena	38	56	0	123	18	0
Port Bodega	38	21	0	122	39	0

Point (
Island
Island
Point (
Point I
Emeral
Point (
Quito
Cape P
Cape d
Guaya
Paita
Truxill
Callao
Lima
Ylo .
Arica
Copeap
Coquin
Valpara
Concep
Mocha
Valdivi
Chiloe,
—Sout
Cape I
Cape N
Cape F

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und

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[redacted]

TABLE XXVIII. Of Latitudes and Longitudes.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Cape Frio	23	0	0S.	42	10	0W.
Cape St. Thomas ...	21	42	0	41	6	0
Espiritu Santo	20	12	0	40	28	0
Abrolhos Shoals	18	0	0	39	28	0
Porto Seguro	16	45	0	40	27	0
B. Todas Santos	12	58	0	39	58	0
R. St. Francisco	10	54	0	37	6	0
Cape St. Augustine ..	8	34	0	35	4	0
Pernambuco	6	48	0	35	16	0
Cape St. Roque	5	6	0	35	46	0
Cape Baxas	3	2	0	41	59	0
St. Louis de Maranhain	2	27	0	45	38	0
River Para, Entrance	0	30	0N.	48	24	0
River Amazon, Entr.	0	32	0	50	46	0
Cape North	1	50	0	50	15	0
Cayenne	4	56	40	52	4	15
River Surinam, Entr.	5	57	10	55	15	0
River Berbice, Entr.	6	21	0	57	7	0
River Demerara, Entr.	6	44	50	58	3	0
River Essequibo, Entr.	6	55	0	58	15	0
River Oronoco, Entr.	8	28	30	60	5	0
Cape Tres Puntas ...	10	48	0	62	45	0
Testigos Isle	11	24	0	63	12	0
Margarita, I. E. Point	11	0	0	63	52	0
— West Point	11	0	0	64	30	0
Blanca I., North End	11	52	0	64	41	0
Tortuga, East End ..	10	55	30	65	12	0
— West Point	10	57	0	65	25	0
Cuagua	10	50	0	64	16	0
Cumana	10	27	0	64	15	0
Barcelona	10	8	0	64	46	30
Peritu	10	4	0	65	16	0
Cape Codera	10	36	0	66	6	0
Guayra	10	37	30	66	58	0
Port Cabello	10	29	30	68	4	30
Point Tucacas	10	54	0	68	19	0
Cape St. Roman	12	11	0	70	6	0
Orchilla I., E. Point .	11	51	0	66	2	0
— West ditto	11	52	0	66	10	0
Rocca, East Point ..	11	59	30	66	36	0
Grande Key, E. Point	11	49	0	66	34	0
Salt Key, East End ..	11	48	0	66	51	0
I. des Aves	12	0	0	67	30	0
Buen Aire, N. Point	12	20	0	68	25	30
Point de Lacre	11	55	30	68	18	0
Curazao,						
Savenet's Bay	12	18	0	69	12	0
St. Crux, Bay	12	12	0	69	7	30
Amsterdam Harbour	12	8	0	69	0	0
Orua Isle, East End	12	24	0	69	59	0
— N. W. End	12	38	30	70	9	0
The Monks, Middle	12	27	0	70	54	0
Cape Chichivacoa....	12	16	0	71	18	0
Cape de la Vela	12	10	0	72	14	0
Needle Point	11	20	0	74	10	30
Carthagena	10	25	19	75	27	0
Island Fuerto	9	21	0	76	12	0
Pta. de S. Blas	9	35	0	78	44	0
Puerto Bello	9	33	0	79	33	0
Port of Cartago	9	19	30	80	0	0
Sandy Point	10	39	0	82	35	0
St. John's Harbour ..	10	41	0	83	10	0
Corn I., N. End	11	39	0	82	14	0
St. Andrew's Isl. North Key	12	37	0	80	48	0

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Cape Gracias a Dios .	15	0	0N.	82	46	0W.
Cape Camaron	16	1	0	85	7	0
Cape Honduras	16	2	0	85	54	0
Cape Three Points ..	15	22	0	88	39	0
Bonacca Island;						
— South West Point	16	26	30	85	54	0
Rattan Island, Port Royal Harbour ..	16	22	20	86	27	0
Utila, East End	16	7	30	87	4	0
Glover's Reef, N. End	16	43	0	87	37	0
Bokell Key	16	56	0	87	47	0
Viciosa, East Point ..	19	0	0	84	38	0
Misteriosa, N. Point .	19	41	0	84	20	0
Consumel I., N. Point	20	8	0	86	34	0
Loggerhead Key, North Point ...	21	37	45	86	51	0
Catonch Cape	21	26	10	86	55	0
Alacran	22	25	0	89	27	0
Bermega Island, Mid.	22	34	0	91	20	0
Sandy Islands	22	7	0	91	25	0
New Bank	21	50	0	91	48	0
Triangles, Northernmost	22	58	30	92	47	0
Las Arcas	20	10	0	92	5	0
Campeeche	20	2	10	90	25	0
Vera Cruz	19	5	0	96	0	0
Cape Roxo	21	44	0	97	10	0
Marine Bar	23	42	0	97	23	0
Boca Chica	25	21	45	97	4	0
Mouth of Rio Brava ..	25	53	0	97	3	0
Horse Channel	28	9	0	97	10	0
Point Culebas	29	9	0	96	52	0
Ent. of the River Mississippi	29	1	0	89	10	0
New Orleans	29	54	30	90	9	0
St. Blas Cape	29	36	0	85	32	0
Egmont I. Ent. of Spiritu Santo Bay	27	37	0	82	43	0
Boca Grande, Entrance of Carlos Harbour	26	40	0	82	13	0
Cape Roman	26	1	0	81	50	0
— Dry Tortugas Sh.						
— S. W. Point	24	30	0	82	55	0
Looe Key	24	29	0	81	32	0
Cayo Largo	24	50	0	80	37	0
Cape Florida	25	42	0	80	12	30
New Inlet	26	22	0	80	9	0
Granville Inlet......	26	45	20	80	6	0
Hillsborough Island, South Point ...	27	16	10	80	15	0
Cape Canavaral	28	18	0	80	30	0
Shoal off Ditto, S E. Point	28	13	0	80	14	0
— N. E. Point	28	24	0	80	12	0
St. Augustin	28	49	0	81	35	0
St. John's River, Entrance	30	20	0	81	50	0
Talbot I., S. End ..	30	28	0	81	57	0
Sunken Rocks, off Ditto	30	22	15	81	27	0

—Scarborough	11	0	0	60	43	0
—Brown's Point ...	10	59	0	60	54	0
Island of Trinidad,						
— Galera Point	10	51	0	60	56	0
— Galgara Point ...	10	9	0	61	0	0
Soldier's Island	10	3	30	62	5	0
— Jaque Point	10	2	20	61	58	0
— Ape's Island	10	42	0	61	47	0
Island Grenada,						
— St. George	12	1	0	61	55	0
— Salin's S. W. P. ..	11	59	0	61	57	0
— Le Grand Marquis	12	7	5	61	42	0
— Goave	12	12	0	61	54	0
Grenada Bank, with only three Fathoms about the Middle of it	11	55	0	62	21	0
Grenadines,						
Isle Levora	12	17	30	61	43	0
Isle Ronde	12	21	0	61	41	0
Carriacou	12	28	30	61	31	0
Little Martinico	12	31	0	61	28	0
Union	12	36	0	61	32	0
Sail Rock	12	40	20	61	27	0
Maycro	12	40	0	61	29	0
Canouan	12	42	30	61	27	0
Moustiques	12	51	10	61	18	0
Balleso	12	55	0	61	16	0
Ballewya	12	58	15	61	15	0
Bequia	13	0	0	61	24	0
Young's Island	13	7	0	61	21	0
Island St. Vincent,						
— Kingstown, N. P.	13	9	0	61	23	0
Chateau Belair, S. Pt.	13	17	0	61	22	0
— Spanish Point ...	13	21	15	61	19	0
— Point Colonery ..	13	12	0	61	16	0
— Rabishi	13	9	0	61	18	0
Isle St. Lucia,						
Cape Grose Le Cap ..	13	56	0	61	6	0
Cape Sable	13	42	0	61	5	0

Deseada, N. E. Pt.
— S. W. Point ....
— Saints' Islands ...
Montserrat,
— North East Point
— Redonde ....
Antigua, East Point .
— English Harbour .
Barbuda, N. Point ..
St. Christopher, S. E. Point ......
— Basse Terre ....
— Nevis Town ....
— St. Eustatius, Town ....
Island Saba ....
St. Bartholomew, East Point .....
St. Martin, S. Point
— North Point ....
Anguilla, N. E. Poi
— Prickly Pear ...
Santa Cruz,
— East Point .....
— S. W. Point ....
Virgin Islands,
— Anegada, W. Poi
— Horse Shoe, with only from 2 to 6 Feet off do. S. E. Point ....
Virgin Gordo, E. E
Tortola, W. End .
St. John's, S. Point
Bird's Key ......
St. Thomas, E. Poi
Bequa, or Crab Island, E. Point
Porto Rico,
— Cape St. Juan

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Cape Raphael......	19	1	30N.	68	51	0W.
Cape Enganio, or False Cape	18	33	0	68	18	0
St. Domingo Town ..	18	26	30	69	48	0
Tortuga, E. Point	20	1	30	72	32	0

Islands and Shoals North of Jamaica and Cuba.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
East Reef, Middle of it	20	6	30N.	68	40	0W.
Superb Shoal, Middle	20	58	0	69	0	0
Silver Keys, South Reef	20	14	0	67	27	0
N. E. Point of do. ..	20	30	0	69	23	0
Western Edge, Silver Keys	20	28	0	69	57	0
Square Handkerchief,						
—N. E. Point	21	4	0	70	27	0
—S. W. Do.	20	52	15	70	54	0
Grand Turk Island, — N. E. end	21	32	0	71	3	0
Sand Key, Middle ..	21	10	30	71	10	0
Great Caycos Island, — South Point ...	21	32	15	71	26	0
Cape Comet	21	43	0	71	24	0
Caycos Shoal, S. E. Pt.	20	58	20	71	31	0
——— S. W. Pt.	20	58	0	71	51	0
Little Caycos Island, North Point	21	41	0	72	26	0
Providence Caycos I. North End	21	49	0	72	19	0
Heneaga Id. N. E. Pt.	21	17	30	73	2	0
——— S. E. do.	20	59	30	73	4	0
——— S. W. do.	20	52	0	73	39	0
——— W. do.	21	7	0	73	37	0
Little Heneaga Id. — East Point	21	28	0	72	56	0
Hogsties, Middle part	21	38	0	73	49	0
Mayaguana Id. S. Pt.	22	15	25	72	47	0
——— N. W. do.	22	27	20	73	6	0
——— S. W. do.	22	22	0	73	8	0
French Keys, Middle	22	38	0	73	30	0
Atwood's Key, N. E. Point	23	10	30	73	32	0
Castle Island	22	6	30	74	16	0
Crooked Island, N. W. Point	22	47	30	74	13	30
Mira Para, Vos Keys, Middle ..	22	5	0	74	28	0
Watland Isl. S. End	23	55	0	74	34	0
Rum Key, Middle	23	33	30	74	56	0
Little Island, S. End	23	49	30	75	16	0
Key Verde	22	0	0	75	3	0
Yuma Isl. S. E. Pt.	22	50	40	74	45	0
—North End	23	30	0	75	19	0
Gunahana Isl. S. Pt.	23	58	0	75	30	0
—North Point	24	37	30	75	47	0
Powel's Point	24	38	0	76	34	0
Egg Island	25	27	0	77	24	0
New Providence, Nassau Town ..	25	4	0	77	37	0
Andros Isl. N. Point	25	25	0	78	22	0
—South Point	24	4	0	78	7	0
Great Isaac Isl. N. Pt.	25	55	0N.	79	20	0W.
Cat Keys	25	24	0	79	18	30
Hole in the Wall ...	25	58	0	77	35	0
Lit. Baham Bank, N. W. Point ...	27	48	0	79	15	0
Memory Rock	27	4	0	79	6	0
Orange Keys, Mid.	24	33	30	79	9	0
Double-headed Shot Keys, W. Point ..	23	56	20	80	12	0
Anguilla, S. E. Pt.	23	29	0	79	12	0

Island of Jamaica.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Morant Pt. S. E. End	17	58	0N.	76	7	30W.
Port Royal	17	57	0	76	53	0
Portland Point	17	42	0	77	12	0
South Negril	18	15	0	78	35	0
Montego Bay	18	32	0	78	7	0
Galina Point	18	30	0	76	57	0
Port Antonio	18	14	0	76	27	0
Morant Keys, N. E. Point	17	26	0	75	57	0
—S. W. Point	17	22	0	76	0	0
Formigas Shoal, Mid.	18	31	30	75	45	0
Portland Rock	17	11	0	77	12	0
Little Cayman Isl. South Point ...	19	40	0	79	47	0
Great Cayman, E. Pt.	19	28	0	80	36	0
—S. W. Point	19	27	0	81	3	0
Swan Island, Mid. ..	17	24	0	83	35	0

Island of Cuba.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Cape Maysi	20	13	0N.	74	0	0W.
Cumberland Harb. ..	19	53	10	75	12	0
Cuba	19	57	0	76	4	0
Cape Cruz	19	48	30	77	38	0
Isle of Pines, S. W. Pt.	21	19	0	82	54	0
Cape Corientes	21	42	16	84	23	0
Cape Antonio	21	55	0	84	55	0
Honda Bay	22	54	10	83	6	0
Havannah	23	8	20	82	17	0
Pan Matanzas	23	0	0	81	35	0

United States of America.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Cumberland I. S. End	30	44	15N.	81	58	0W.
Savannah River, Ent.	32	3	0	81	0	0
Port Royal, Ent.	32	12	0	80	44	0
Castletown Light ...	32	45	0	80	5	0
Cape Roman	33	3	30	79	28	0
George Town	33	27	20	79	25	0
Cape Fear	33	50	15	78	29	0
Frying-pan Shoal, off ditto	33	31	30	78	18	0
Cape Lookout	34	23	0	77	10	0
Shoal off ditto	34	9	0	77	5	0
Cape Hatteras	35	8	0	76	2	0
Shoals off ditto	34	47	30	75	27	0
Cape Henry	36	57	0	76	10	0
Cape Charles	37	12	0	76	7	0
Chingoteak Island ..	38	0	0	75	20	0

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Thirteen Feet Bank, off Chingoteak I.	38	6	20N.	74	47	0W.
Cape James	38	46	30	75	8	0
Cape May	39	0	0	74	58	0
Philadelphia	39	56	30	75	17	0
Sandy Hook Lighth.	40	26	30	74	6	0
New York	40	41	45	74	8	0
Montuk Point	40	5	0	72	6	0
Block Island	41	11	0	71	46	0
Point Judith	41	23	0	71	38	30
Newport, Rhode Isl.	41	29	0	71	15	0
Gay Head	41	22	0	70	57	30
Sandy Pt. Lighth. Nantucket Island	41	21	0	70	4	0
Southern Breakers ..	40	43	30	70	0	0
Cape Cod Lighthouse	42	5	0	70	18	0
Boston Lighthouse	42	22	0	70	34	0
Boston Town	42	19	0	71	5	0
Marble Head	42	32	9	70	54	0
Salem	42	34	20	70	55	0
Baker's Island Lighth.	42	35	25	70	50	0
C. Anne Lighth. Thatcher's Island	42	40	10	70	39	0
Newberry Port Lights	42	48	30	70	51	0
Portsmouth Town ...	43	5	15	70	45	0
Isles of Shoals	42	57	0	70	38	0
Boon Island	43	6	0	70	32	0
Cape Elizabeth	43	33	20	70	12	0
Portland Lighthouse	43	39	0	70	12	0
Cash's Ledge, Middle Reef ...	43	5	0	69	13	0
Seguin Island	43	41	20	69	47	0
Kennebeck R. Ent.	43	43	0	69	47	0
Bantam Ledges	43	42	15	69	9	0
Manheigin Island ...	43	44	25	69	21	0
Martinicus Island ..	43	50	0	69	1	0
Mount Desert Rock	43	52	0	68	11	0
Grand Manan Isl. West End	44	30	0	67	9	0
Wolves' Islands	44	47	30	66	55	0
Island of Campo Bello, or West Passage, Passamaquady Bay ..	44	50	0	67	9	0
Sante Croix River ..	45	0	0	67	6	0

From the River St. Croix, to Cape Canso in Nova Scotia.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Mugone's Island, Entrance of St. John's River ..	45	18	20N.	66	4	0W.
Cape Spencer	45	17	16	65	55	0
Cape Chignecto, Ent. of Bason of Mines &c.	45	24	20	64	49	0
Hauto Island	45	19	12	64	52	0
Annapolis Royal	44	47	10	65	55	0
Breyer's Island	44	19	0	66	25	0
St. Mary's Cape	44	10	15	66	12	0
Cape Forchu	43	52	20	66	9	0
Seal Isles	43	27	45	66	0	0
Cape Sable	43	27	11	65	35	0
Port Roseway	43	40	15	65	17	0
[illegible] of Hope	43	53	10	64	44	0
Port Jackson	44	13	0N.	64	27	0W.
Charlotte Bay	44	34	25	63	55	0
C. Sambro Lighth.	44	30	15	63	32	0
Halifax Harbour ...	44	36	10	63	28	0
Port Stephens	45	0	45	61	58	0
Sandwich Bay	45	8	50	61	36	0
Torbay	45	12	20	61	16	0
Port Howe	45	13	30	61	5	0
Cape Canso	45	16	0	60	55	0
Sable Isl. East Point	44	8	25	60	0	0
———West Do.	44	4	15	60	35	0

The Gulf of St. Lawrence.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
St. Paul's Island	47	11	15N.	60	0	0W.
Bird Islands	47	55	20	60	41	0
Brion Island	47	52	10	61	0	0
Magdalen Is. N. E. Pt.	47	41	0	61	0	0
———S. W. Do.	47	12	5	61	41	0
Entry I.	47	15	30	61	21	0
Deadman's Island ...	47	15	20	61	53	0
I. of Antecosta, E. Pt.	49	8	35	61	39	0
———S. W. Do.	49	22	15	63	23	0
———West Do.	49	48	20	64	23	0
———North Do.	49	53	10	64	0	0
I. de Bik, in the R. St. Lawrence ..	48	32	15	67	55	0
Mount Camille	48	37	20	67	20	0
Cape St. Ann	49	8	0	66	55	0
Magdalen River	49	13	15	65	18	0
Cape Rozier	48	47	10	64	1	0
C. Gaspe and Bay ..	48	41	20	63	58	0
Flat Point	48	34	0	63	59	0
I. Bonaventure	48	24	11	63	58	0
Cape Despair	48	28	5	64	6	0
Miscou I. Ent. of Chaleur Bay ...	48	0	30	64	21	0
P. Escuminac	47	1	45	64	42	0
St. John's I. N. C. ..	47	2	20	63	54	0
———West Point ..	46	34	15	64	16	0
———East Ditto ..	46	27	0	61	53	0
———Bear Cape ..	46	0	10	62	18	0
Hilsborough Bay ...	46	6	12	63	0	0
Cape St. George	45	51	15	61	49	0
Gut of Canso, N. Ent.	45	42	20	61	27	0
Justa Corp Island ..	45	56	10	61	27	0
Port Hood	45	57	0	61	25	0
C. North Isl. off Cape Breton ...	47	1	5	60	15	0
Port Dauphin	46	23	30	60	18	0
Spanish Bay	46	18	15	60	2	0
Flint Island	46	11	35	59	38	0
Scatari Island	46	2	10	59	32	0
Cape Breton	45	57	40	59	44	0
Louisburg	45	54	0	59	54	0
C. Hinchinbroke	45	34	15	60	29	0
Isle Madame	45	29	30	60	49	0
Gut of Canso, S. Ent.	46	28	30	60	51	0
Chedabucto Bay	46	23	10	60	51	0

TABLE XXVIII. Of Latitudes and Longitudes.

Newfoundland.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Limits of the Great Bank of Newfoundland, N. Pt.	50	15	20N.	50	0	0W.
Ditto, South Point ..	41	0	0	52	0	0
Outer, or False Bank	47	0	15	45	0	0
Virgin Rocks	46	30	10	51	35	0
Cape Race	46	42	30	52	49	0
Cape Ballard	46	49	20	52	42	0
Cape Broyle	47	7	15	52	35	0
Bay of Bulls	47	21	16	52	29	0
Cape Spear	47	30	20	52	20	0
St. John's Harbour ..	47	32	20	52	25	0
Cape St. Francis	47	54	15	52	30	0
Point of Grates	48	22	0	52	35	0
Trinity Bay	48	30	40	53	5	0
Cape Bonavista	48	52	30	52	40	0
Barrow Harbour	48	50	0	53	5	0
Funk Island	50	1	15	52	17	0
Cape Freels	49	34	10	53	0	0
Wadham Islands	49	54	5	53	30	0
Gander Bay	49	40	16	54	15	0
Fogo Island	50	0	12	53	54	0
Twillingate Islands ..	50	3	20	54	40	0
Bay of Notre Dame	50	0	0	55	35	0
Cape St. John	56	10	0	55	38	0
Horse Islands	56	21	45	56	51	0
White Bay	50	15	15	56	25	0
Hooping Harbour ..	50	46	0	56	18	0
Green Island	50	47	20	55	35	0
Groais Island	50	55	5	55	45	0
Hare Bay	51	15	10	56	1	0
St. Anthony's Cape	51	17	30	55	44	0
Quirpon Harbour ..	51	40	20	55	39	0
Belleisle	51	55	15	55	30	0
Cape Norman	51	40	5	56	2	0
Bay St. Barbe	51	15	17	56	53	0
Point Ferolle	57	3	0	57	11	0
St. John's Island	50	50	20	57	23	0
Ingornachoix Bay ...	50	38	30	57	25	0
Bay St. Paul	49	50	50	57	55	0
Cape St. Gregory ...	49	22	15	58	17	0
South Head	49	7	40	58	26	0
Cape St. George	48	30	45	59	13	0
Cod Roy Island	47	52	10	59	23	0
Cape Ray	47	37	0	59	15	0
Great Barrisway	47	37	15	57	45	0
Burgeo Islands	47	35	0	57	37	0
Runney Island	47	32	20	57	30	0
Penguin's Islands ..	47	24	15	57	5	0
Fortune Bay	47	16	10	55	35	0
Burnet	47	15	35	56	1	0
Great Miquelon	46	55	15	56	21	0
Langley Island	46	42	20	56	20	0
St. Peter's Island	46	36	10	56	11	0
Cape Chapeau Rouge	46	52	0	55	22	0
Bay of Placentia	47	0	10	54	35	0
Cape St. Mary's	46	52	5	54	7	0
St. Mary's Bay	46	50	15	53	35	0
Cape Pine	46	40	20	53	20	0

From Quebec to Hudson's Bay.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Quebec	16	55	11N.	69	53	0W.
St. Paul's Bay	47	30	20	69	15	0
Bay of Rocks	48	5	15	68	43	0
Laval Bay	18	55	30	68	50	0
St. Nicholas's Bay ..	49	28	41	67	5	0
Trinity Bay	49	37	24	66	32	0
The Seven Island Bay	50	7	16	65	50	0
Grand Bay, St. John's	50	22	5	64	5	0
Mingan Island	50	16	10	63	20	0
Esquimaux Islands ..	50	12	30	63	5	0
Mount Joli	50	5	0	61	35	0
Little Mecatina Island	50	28	15	59	32	0
Great Mecatina Point	50	52	14	59	13	0
Haha Bay	50	52	20	59	7	0
Esquimaux Bay	51	28	10	57	50	0
Grand Point	51	24	0	57	17	0
Forteau Bay	51	30	20	57	0	0
Red Cliffs	51	33	40	56	50	0
Black Bay	51	40	20	56	47	0
Red Bay	51	44	5	61	25	0
York Point	51	57	10	55	57	0
Cape Charles	54	13	12	55	30	0
Great Bay of Esquimaux	54	20	0	57	35	0
Cape Harrison	54	54	15	56	50	0
St. Peter's Harbour ..	56	28	10	60	50	0
Inchanted Cape	56	40	20	60	55	0
Saddle Islands	57	13	30	60	50	0
East Island	57	45	0	61	20	0
Steel Point	58	7	10	61	50	0
Cardinal's Island	58	50	40	63	0	0
False Black Head ...	59	20	20	69	19	0
Black Head	59	50	15	63	37	0
Button's Islands	60	47	50	65	21	0

Hudson's Bay.

Names of Places.	Latitude. D.	M.	S.	Longitude. D.	M.	S.
Button's Islands	60	47	5N.	65	21	0W.
Lowe's Savage Island	61	48	20	66	25	0
Terra Nieva	62	4	30	68	5	0
Saddle Back Island ..	62	10	10	68	15	0
Great Bear Island ...	54	4	20	80	1	0
Ice Cove	62	0	0	69	5	0
Baker's Dozen	57	0	5			
Great Savage Island	62	25	25	70	5	0
North Bluff	62	26	15	71	15	0
God's Mercies	62	28	0	70	53	0
Salisbury Island	63	30	45	76	55	0
Nottingham, East End	63	35	30	76	50	0
Cape Charles, East End	62	50	22	74	20	0
—West End	62	40	5	76	5	0

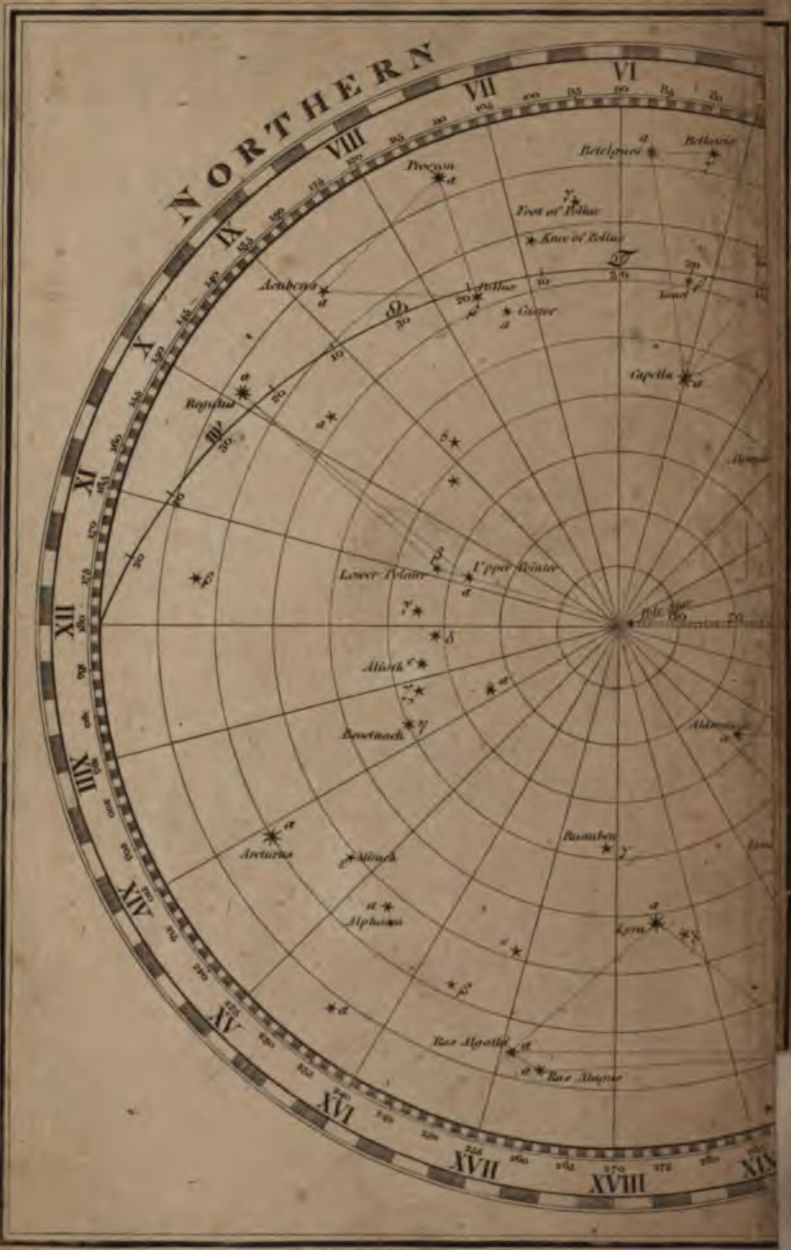

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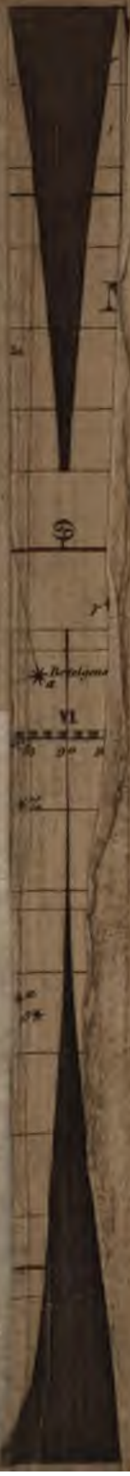
TABLE XXIX. HIGH WATER.

	H.	M.
Finmark (Coast of), in general	2	15
Flamborough Head and Filey	4	30
Flats (Kentish), England	12	0
Flatholm Island, Bristol Channel	6	40
Flemish Banks, North Sea	3	0
Florida Keys, America	8	50
Flushing, Holland	1	0
Fly (or Vlie) Gateway, Holland	6	45
Fly (or Vlie) Road, Holland	7	30
Folkstone, England: *r.* 20 *ft.*	10	51
Fort George, Scotland	12	0
Forteau Bay, America	11	0
Foul Isle, near Shetland	3	0
Fowey, England: *r.* 16 *ft.*	5	30
Frith of Tain, Scotland	11	0
Funchall, Madeira: *r.* 7 *ft.*	10	30
Galloper and Gabbard, Thames Mouth: *r.* 16 *ft.*	12	45
Galway Bay, Ireland	4	30
Galloway (Mull of), Scotland	11	15
Gambia (River, Ent.) Africa	10	15
Gaspe Bay, America	1	30
Gay Head, America: *r.* 7 *ft.*	7	37
George's River, America; *r.* 9 *ft.*	10	45
George Town Bar, America	6	40
Gibraltar, Spain: *r.* 5 *ft.*	12	0
Glasgow Port, Scotland	11	30
Goa, India	4	30
Goodwin Sands, Back of the	1	30
Gore, near Margate, England	12	0
Goree Gateway, German Ocean	1	30
Grangemouth, England	2	30
Granville, France	7	30
Gravelines, France: *r.* 18 *ft.*	11	45
Gravesend, England: *r.* 16 *ft.*	1	30
Gresholm, near Milford Haven	7	30
Guayaquil (Port), South America	6	30
Guernsey, British Channel: *r.* 30 *ft.*	6	0
Gulf of Corryvrechan, Lewises: *r.* 11 *ft.*	4	30
Gut of Canso, America	8	30
Haerlem, Holland	9	0
Hague, Holland	8	15
Hogue (Cape La), France: *r.* 16 *ft.*	8	45
Halifax, Nova Scotia: *r.* 8 *ft.*	7	30
Hamburgh, Germany	6	0
Hampton Quay, England	12	0
Hanford Water, England: *r.* 16 *ft.*	12	0
Hartland Point, England	6	0
Hartlepool, England	3	45
Harwich, England: *r.* 14 *ft.*	11	30
Hasborough, England	7	30
Hasborough Sand, North Sea	8	0
Hastings, England	10	36
Havre de Grace, France: *r.* 22 *ft.*	10	30
Helena (St.), Atlantic Ocean	2	15
Helena (Cape St.), America	4	0
Helford, England: *r.* 18 *ft.*	5	15
Helgoland, German Ocean: *r.* 9 *ft.*	11	0
Helen's (St.), England: *r.* 16 *ft.*	11	45
Helvoetsluys, Holland	1	30
Henlopen (Cape), America	8	54
Henriette Marie (Cape), Hudson's Bay	12	0
Holms (Flat and Steep), Bristol Channel: *r.* 36 *ft.*	6	40
Holyhead Bay, Wales: *r.* 24 *ft.*	10	0
Holy Island Harbour, Scotland: *r.* 15 *ft.*	2	30
Honfleur, France	9	0
Hook of Holland	3	0
Hooringottah River, East Indies	12	0
Horn (Before the), German Ocean	12	0
Horse Race, America: *r.* 5 *ft.*	10	30
Hosley Bay, England: *r.* 11 *ft.*	11	0
Hull, England: *r.* 18 *ft.*	6	0
Humber (Entrance), England	5	15
Hung Road, England: *r.* 46 *ft.*	6	45
Hurst Castle, England	9	30
Ice Cove, Hudson's Bay	10	0
Ila (E. side and Sound of): *r.* 5 *ft.*	3	15
Ilfordcombe, England	6	0
Ingella, India	11	0
Inverkeithing, Scotland	2	45
Ipswich, England	12	0
Ireland, N. W. Coast, from Milen Head to Balliconnel: *r.* 12 *ft.*		
———, W. Coast in general	3	0
———, Havens on the S. Coast	5	51
Isle of Man, South side	10	30
Ives (St.), England: *r.* 24 *ft.*	5	0
Jackson (Port), New Holland	8	15
Jago (Isle), Africa	7	45
Janeiro (Rio), Brazil	4	30
John's (St.), Newfoundland	6	0
Jean de Luz (St.), France	6	0
Jersey Island: *r.* 23 *ft.*	6	0
Juan (Cape St.), America	4	0
Julian (Port St.), Patagonia	4	45
Jutland, (along the Coast of)	12	0
Karakakoo Bay, Sandwich Islands	3	45
Kedgeree, India	11	30
Kenmare River, Ireland	3	45
Kennebeck, America: *r.* 9 *ft.*	10	45
Kentish Knock, off the Thames	11	30
Kilduyn, Lapland	7	30
Killybegs, Ireland	6	45
Kingroad, near Bristol: *r.* 42 *ft.*	6	48
King's Channel or Swin: *r.* 16 *ft.*	12	0
Kinghorn, Scotland	2	30
Kinsale, Ireland	5	15
Kinnaird's Head, Scotland	12	0
Kirkaldy, Scotland	2	15
Kirkudbright, Scotland	11	15
Kirkduyn, Holland, near the Texel: *r.* 12 *ft.*	7	30
Komaroo (Cape), New Zealand	9	30
Labradore Harbour, (Straits of Belleisle)	11	30
Lambaness, North End of Shetland: *r.* 5 *ft.*	9	30
Lancerola, Canaries	12	45
Lancaster, England	11	15
Land's End of England	4	30
Leith Pier, Scotland: *r.* 15 *ft.*	2	20
Lerwick in Shetland	1	30
Lewis and Harris (along the Shores of), Scotland: *r.* 11 *ft.*	6	0
Lewises (Butt of the)	6	45
Lich	12	0
Limekilns, on the Frith of Forth	3	30
Limerick, Ireland: *r.* 16 *ft.*	6	30
Lisbon, Portugal	2	[illegible]
Liverpool (Entrance of the Harbour): *r.* 26 *ft.*	[illegible]	
Lizard Point, on shore, England		


VI


VI

William Rowland is the
True owner of this Navi-
-gation Booke

William Rowlands
his hand
William Rowland

Williams W